# REPORT

of the

# SECOND SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE

July 19 - 22, 1941

Raleigh, N. C.

Reported by

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REPORT OF THE SECOND SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE, JULY 19 - 22, 1941

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# MINUTES OF EXECUTIVE AND BUSINESS SESSIONS OF SOUTHERN PASTURE AND FORAGE CROP CONFERENCE

February 5 and 6, 1941, Atlanta, Georgia

## I. Executive Meeting

1. Present - Fergus, Burton, Blaser, Aamodt.
2. Dr. Burton was elected chairman for 1941.
3. Agenda developed for meeting to be held at the close of the Joint Agronomy-Livestock Program on Thursday afternoon, February 6.
4. Agreed that livestock interests should be represented on the Committee.

## II. Business Meeting Pasture and Forage Crop Conference

1. Approximately 75 persons present.
2. Minutes of 1940 Summer Conference at Tifton, Georgia, accepted as read. A mimeographed report has been compiled by the Secretary and will be available for distribution by the end of February.
3. The Chairman pointed out that the livestock groups were not represented on the Conference Executive Committee. After discussion Mr. Blaser moved and Mr. Lush seconded the motion that the Dairy Science and Animal Husbandry Sections of the Association of Southern Agricultural Workers be asked to appoint one representative each to the Executive Committee. (The Secretary was informed that Prof. J. P. LaMaster, of the South Carolina Agricultural Experiment Station, was appointed to represent the Dairy Science Section, and E. H. Hostetler, of the North Carolina Agricultural Experiment Station, to represent the Animal Industry Section.)

4. The Chairman called for nominations for the vacancy on the Executive Committee by the expiration of the service term of E. N. Fergus. Dr. H. R. Albrecht, of the Alabama Agricultural Experiment Station, was nominated, seconded, and unanimously approved.

5. The Chairman called for discussion of time and place for the 1941 Summer Conference. Invitations were presented by Mr. Harold Mowry, of the Florida Agricultural Experiment Station; Prof. E. N. Fergus, Kentucky Agricultural Experiment Station; Prof. L. D. Baver, North Carolina Agricultural Experiment Station. The group voted to meet at the North Carolina Agricultural Experiment Station, Raleigh, with instructions that final arrangements for the conference to be made by the Executive Committee.

6. The Chairman agreed to circulate the Executive Committee relative to place of meeting and the Secretary to develop a tentative program for the Summer Conference in consultation with the staff members of the host institution.

O. S. Aamodt
Secretary

SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE
NORTH CAROLINA STATE COLLEGE AND EXPERIMENT STATION

RALEIGH, N. C.

July 19-22, 1941

Headquarters: Department of Agronomy Ricks Hall

Special attention was given this year to statistics and related fields in the Summer Session of the North Carolina State College. The last week, July 14-18, was devoted to Agronomic and Horticultural experimental problems. Pasture problems were discussed the last two days. The annual conference of the Southern Pasture and Forage Crop Committee was arranged to suit the convenience of those wishing to participate in all, or a part of, the special work on statistics.

One of the College dormitories was reserved for students and visitors. Provisions were made for married couples, single men and women to stay in this dormitory.

Saturday, July 19

9:00 A.M. Room 207 Building: Daniels Hall

Informal consultation with teaching staff on Pasture Experiments.

During the morning the group visited the Soil Conservation Service nursery at Chapel Hill, North Carolina. Particular attention is being paid to grasses at this nursery, and the collection is the most complete for the Southeast and one of the most complete for the United States.

2:00 P.M.

Visit to Smithfield Grass Plots - R. L. Lovvorn (Approximately 30 miles southeast of Raleigh on U. S. Highway No. 70)

The pasture studies of the N. C. Agricultural Experiment Station on the upper Coastal Plain east of Raleigh were visited in the afternoon. Here 22 seeding mixtures have been grown under six soil fertility levels since 1937. Dallis is proving to be the best adapted grass in this experiment. Annual lespedezas have been the most dependable legumes in the mixtures, although at the time the group visited the experiment the white clovers were outstanding. This was particularly true for Ladino clover. Apparently the season had been ideal for its growth.

The nutritional requirements of the individual species may be briefly summarized as follows: Lespedeza - phosphate and to a lesser extent potash; low hop clover - phosphate and limestone; white clovers - limestone, phosphate and potash; grasses - nitrogen. The addition of mineral fertilizers and legumes to a Dallis grass sod has resulted in a 300 percent increase in yield.

Sunday, July 20

7:30 A.M.

Visit pasture and forage work at the Willard Station (Approximately 120 miles southeast of Raleigh on U. S. Highway No. 117 - Spur State No. 401, 2 miles south of Wallace turning west), Supt. Charles Dearing, R. L. Lovvorn and E. W. Faires. An excellent dinner was served at the Station by Supt. Charles Dearing.

Those attending church services in the morning were given an opportunity to visit the experimental plots after the dinner at the Station.

Approximately 60 made the trip to the Lower Coastal Plain Station. There the Bureau of Plant Industry and Bureau of Dairy Industry of the U. S. Department of Agriculture, the State Department of Agriculture, and the Departments of Agronomy and Animal Husbandry of the North Carolina Agricultural Experiment Station are cooperating in the development of a pasture program for the tidewater country. The adaptability of white, low hop, subterranean, bur and crimson clovers are being investigated when grown in association with Dallis grass. Ladino clover was the outstanding legume at the time of the visit. Yields of Dallis plus legumes show calcium to be the first limiting factor in the production of pasture herbage on this soil.

The other nutrients needed in order of importance are - phosphorus, potassium and nitrogen. Various cultural experiments are also under way in which attempts are being made to introduce legumes into carpet grass sod. Single disking has proven to be an effective way of adding lespedeza. The grazing program includes the utilization of soybeans, small grains and other annuals.

## MINUTES OF BUSINESS SESSION OF SOUTHERN PASTURE AND FORAGE CROP CONFERENCE

July 22, 1941 - Raleigh, N. C.

1. Consideration was given to the desirability and form of reports of the annual conferences. It was generally agreed that a report should be developed along the lines of the report covering the annual meeting at Tifton, Georgia in 1940. Through the kindness of the North Carolina Agricultural Experiment Station, arrangements were made for a number of trainees to record the papers and discussions verbatum with stenotype machines. There was a brief discussion as to whether, under the circumstances, the material should be reported as verbatum by those participating. It was left to the Secretary and his committee to make the final decision on the form of the report after the material was received from the reporters.

NOTE - Owing to the inexperience of the reporters, the material was in such shape that it was impossible to make an accurate verbatum report of all of those participating in all of the discussions. Consequently, a general statement was prepared from the incomplete reports covering each topic.

2. The chairman called the attention of the group to the fact that the annual meeting of the Association of Southern Agriculturists would be at Memphis, Tennessee, early in 1942. Since some of the members had raised the discussion as to where the Southern Pasture and Forage Crop Committee would have its next summer meeting, it seemed desirable to have some discussion at this time as to where and when the next conference should be held. It was pointed out that the attendance of the members of the conference was much greater at the time of the summer meeting than at the annual meeting of the Association in the winter. Consequently, it would seem desirable to hold the annual business meeting at the time of the summer conference rather than during the winter meeting. This was generally agreed upon. The thought was expressed and generally agreed upon that the shifting of the business meeting at the time of the summer conference should in no way interfere with the Program Committee of the Association of Southern Agriculturists in arranging for joint programs dealing with pasture and forage crops. It was pointed out that it would also be desirable to make a brief report of the activities of the Southern Pasture and Forage Crop Conference group to the Association at the time of the winter meetings.

3. Three possibilities were presented for discussion:

(a) Gainesville, Florida
(b) West Point, Mississippi
(c) Lexington, Kentucky

The group finally agreed to meet at Gainesville, Florida, in 1942. The desires of the conference group were later presented to Director Wilmon Newell, of the Florida Experiment Station, who responded as follows:

> "It will indeed be a pleasure to have the Grassland Conference held in Gainesville at the Florida Agricultural Experiment Station next year and we extend a most cordial invitation and trust that the Executive Committee can accept. It will indeed be an honor to have this group meet with us at any time and you may rest assured that an individual invitation is not necessary. We shall be glad to have you at any time."

4. The time of meeting in 1942 was discussed briefly. There were three suggestions: (1) To meet about the time of Easter vacation, (2) to meet the last week in July, as has been done during the past two years, and (3) to meet approximately the first week in June. Most of those present indicated that it would be desirable to shift the meetings to a different time each summer, in order to provide an opportunity to see the crops and experiments at different seasons of the year. Several expressed the opinion that the spring meeting about Easter time would interfere too much with teaching and would probably result in a poor attendance. It was finally agreed that it would be left to the Executive Committee, in consultation with the Florida Agricultural Experiment Station officials, as to the most suitable time of meeting.

5. The chairman closed the meeting with an expression of appreciation to Director Salter and the Agricultural Experiment Station and others at the institution, particularly Professors Baver, Woodhouse, Ben Smith and Rankin for the excellent hospitality and fine treatment extended during the conference. This motion was unanimously passed with a rising vote of thanks.

Monday, July 21

9:00 A.M. Room 207 Building: Daniels Hall

I. Methods for measuring the productivity of pastures

Chairman R. L. Lovvorn

Those attending the conference were called to order by Prof. R. L. Lovvorn. He introduced Dr. Baver, Assistant Director of the Experiment Station and Head of the Department of Agronomy, who welcomed the conference group to the Station.

1. Kinds and management of livestock - Discussion led by R. H. Lush

Economical production of livestock in the South depends primarily on a liberal supply of home-grown feeds, chiefly pasture or other forms of forage. The forage problem in livestock feeding then is to insure a uniform supply of high-quality pasture at minimum cost.

Any phase of the above problem may become a "bottleneck" for successful livestock feeding. The supply of pasture is becoming more adequate as shown by the census figures. Excluding Texas and Oklahoma, the total acreage of plowable pasture in the other 12 Southern States has increased approximately 8,000,000 acres, or 42 percent, in the last decade. The increase in woodland pasture has been about 5,000,000 acres. Hence the total amount of pasture available for livestock grazing is now about 114,000,000 acres, or 13 percent more than it was 10 years ago.

During this same period in these States there has been little change in the total number of horses or sheep, an 11 percent decrease in the number of mules, about 12 percent increase in cows milked, 26 percent increase in total cattle, and an increase of 44 percent in number of hogs. The total number of animal units in these 12 States is now nearly 12,000,000, or 13 percent higher than it was 10 years ago. This indicates there are slightly less than 10 acres of pasture available for each animal unit. The individual States vary from 4½ to 14 acres of pasture per animal unit. Considering only the more valuable plowable pasture acreage, there are 2.3 acres available per animal unit. Much of the rest is of poor quality, or in woodland, and should continue to raise trees. Two acres of pasture per animal unit is hardly enough according to accepted standards. There are, of course, other sources of forage supply such as field crops for grazing, forest land and waste land.

But entire dependency on grazing of these pasture acres cannot give maximum production because of the variation in supply. Results in Louisiana, where pastures were clipped at monthly intervals for 8 years to determine yield, showed two distinct peaks of production.

Sixteen percent of the total yearly production of dry matter was made during April; while 20 percent, the highest peak, was produced in August. However, the dry matter contained 20 percent protein in early spring, and less than 12 percent protein in late summer. Such fresh pasture may be looked upon as a "watered" 20 percent protein feed in early spring, and a 12 percent protein feed in late summer. Any supplemental feeding of livestock, especially of milk cows and hogs, should take into consideration this seasonal variation in pasture composition. The variation in yields of permanent pasture makes it imperative for nearly all classes of livestock that some additional feed be provided to give a uniform daily supply. This may be supplemental grazing crops, hay, or other feeds.

Growing pigs and brood sows may receive 25 to 50 percent of their required nutrients from pasture crops. Work at the Tennessee Experiment Station indicates that growing pullets can consume a similar proportion. Recent work at the Ohio Experiment Station shows that poultry gives higher returns from an acre of pasture than do farm animals. The Mississippi Station has shown that mules on pasture can do hard work with 25 percent less grain, and 50 percent as much hay as team-mates fed in dry lot. Experiments in Virginia and Illinois show that beef can be finished on roughage, consisting chiefly of pasture, to nearly the same degree as those fed in dry lot. Such cattle are at present penalized on the market because of a high color of fat, in spite of the fact that it may contain two to three times as much carotene as beef finished on dry feed. Milk cows on pasture producing over two gallons of milk daily generally need grain in proportion to production. Satisfactory and economical production of 6,000 to 8,000 pounds of milk per cow yearly can be made entirely on pasture or other forms of roughage. Dry stock, sheep, and growing work stock can receive their entire feed supply from pasture. If satisfactory growth is not obtained, it is the fault of the pasture in production and quality rather than the method of feeding.

2. Measuring productivity of grasses tolerant of close grazing - Discussion led by H. A. Hein

I think we are all more or less familiar with the methods that are now in use in measuring the productivity of grasses tolerant to close grazing. Probably the most common is the cage method or the use of some kind of enclosure in which the area is protected from grazing for a definite period of time. The forage under that cage is harvested by a mower or clippers and some have harvested by hand plucking. I happen to be one attempting to use this latter method. The object in any method is to attempt to obtain the herbage similar in quantity and quality to that obtained by the grazing animals. As to the number of cages that are required for any pasture, I do not know what that number should be but it should be enough to give an accurate measure of the herbage yield. There are certain technique studies

that have been conducted in a more or less preliminary way in an attempt to answer this question. There has been some discussion on this subject at the statistical meetings here this last week, but I do not believe any decision was reached. In experiments where smaller plots are used or land limitation reduces the area for experimentation, it is possible to establish the grasses or mixtures in small plots and use a lawn mower for harvesting strips to determine the yield. After the strips have been harvested, cattle or sheep are turned on to the plots and the entire area grazed. Enough animals should be placed on the plots to graze the area in a relatively short period of time. It is advisable to remove the animals after one or two hours grazing or as soon as they appear to have their "fill". It may take two or three days to graze the area under such a procedure. By this method seasonal yield of the grasses or mixtures may be obtained and in addition you get the grazing effect of the animal on the plots. The principle objection to this method is the preference animals may show for an individual grass or mixture and certain plots might be grazed rather intensely but where large numbers of animals are used they will generally graze over the entire area. If, on the other hand, it is already known that some particular grass is not palatable it should not be included in this test.

3. Clipped herbage separation and chemical analyses - Is it worth the cost?

Chairman: One question that we have is this problem of herbage separations. Dr. Sell, you have been doing a lot of work. Can you assist in such a discussion?

Discussion led by O. E. Sell - Our system is to collect our clippings at the time we make our yield determinations in the field. These are put in cold storage and then when winter comes along, our field hands are not busy and we complete the work. I think the question of clipping separations are dependent on your objective. Under some conditions where you wanted to determine the long time removal of a certain amount of fertility from your plots, why a total chemical analysis is probably alright. It is only under certain conditions where you want to determine moisture by separations. We are quite sure we should when we have lespedeza growing with Bermuda grass. The Bermuda grass is lower than lespedeza. There is a need for separation of your clippings of different species, and that may also be true in grazed pastures where you have cages. When clover is grown in the winter Bermuda grass is greatly enhanced. Now, those are special cases where I am sure these separations are well worth while. It is very difficult to keep the herbage constant on the two areas that are harvested differently. Bermuda grass may vary all the way up to 23 or 25 percent. It took much time to separate the lawn mower harvests. On the other hand, we find that clippings can be removed by hand. We set the square foot and then tried to cut to the height the lawn mower

did. We could not do it. We found that we had clipped them too closely. We might overcome that difficulty by further trials.

General Discussion: It is very difficult to identify material that has gone through the lawn mower. If you practice this method of clipping with hand clippers you are reasonably sure of identification. In a little study we made a couple of weeks ago we did find one error. We couldn't distinguish between Plantain and white clover stems. When both ends were cut off they looked exactly alike.

I would like to raise a few questions in connection with clipping. That, of course, is one of your methods for determining yield. It seems to me clipping has a place for yield determination of small plants. If you clip an area too closely, you change the vegetation population very decidedly. The question is, what is right? And then you have other disadvantages. When animals are moving around, they tramp down the grasses eventually, if it is high like most of our pastures. In measuring yield, you might consider another thing. The beef cattle will measure the yield through the live weight gain. Shall we put animals on there and let them graze and produce only so much, or shall we stock that pasture to get the maximum production out of it? You have there two things to consider. And the third thing you might bring in is animal association. Beef animals graze differently from milk animals, and sheep will graze differently from them too. We are using four methods, clippings, milk production, and different animals on the same pasture.

I have one more question that has come to me. I wonder after all, is it important for us to struggle and spend considerable amount of time and money in taking yields with the idea of getting actual yield within a given number of pounds per acre, or is it a matter of relative yield that we are after in taking these clippings year after year? Is it a matter of relative yield of one grass or another, or one of lighter or differential treatment of one compared to another?

Reply: I think you have two different things. You should be just as anxious, but not so precise to get at the yield. But we can be careful to a degree as we would be careless the other way. If we don't use great precision in producing results, are we going to be very accurate? I believe we should be accurate. The value 3.1 is just as accurate with pie as 3.146 but not as precise.

4. Dry versus green weights of clippings - Place for each - Discussion led by R. E. Stitt

If we are going to get comparative yield of material, we must have some basis that is uniform to make these. That calls for dry material or at least to a uniform moisture basis. And in that case we need dry weights. We may not need to take green weights for that purpose unless for some reason or other we do not save the entire clipping or plucking. The chemist may need green weights to correlate results accurately and in the field he may need it to correlate dry matter with some other element in his plants. Plants vary much in maturity as well as in dry matter at a different time of season. I sometimes doubt the advisability of taking green weights where yield alone has been calculated. There may be things for which we should take green weights and if anyone has in mind what we use green weights for after we get them, I would like to hear that discussion. By taking green yields, it is possible for us to make from two to three yield determinations. I think in certain places the green yield has a very definite value, for we have difference in different species. We find for instance that cattail has much more moisture than sudan grass. You can take it in the same stage. So comparing yield test, we don't dare take green weights without making some correction for the difference between the two species.

General Discussion: I would like to make an observation from the standpoint of cattle. Slow growing vegetation is rather low in moisture and rapidly growing is very high in moisture. Grass that has a lot of water causes a decrease in milk flow. This is a rather serious problem. A lot of pastures are dominated by this juicy grass. I would like to add a different point. Dry weights in my opinion have a place, both green and dry. In beginning, we have our pasture work scattered from one end of the State to another. If you have pasture scattered two or five hundred miles, there isn't but one way you can get accurate data and that is to take the green weight and immediately take the green sample from weight we usually use, which we take dry weights. We use green weight in the field, merely as a basis for calculating dry weight.

5. Methods of making yield estimates - Use and value - Discussion led by John P. Gray

Well, I enjoy being over here for the first time. I think we might be interested in how we might make a yield estimate. It has been rather difficult for me to analyze in my own way just what was required of such discussions. I think the whole discussion this morning has been on estimates. We have, after all, different methods for estimating clipping plots. We are still not weighing up tons, and so if I consider from that viewpoint, then I could enter in all

the discussion this morning. The quicker we can make accurate yield determinations under certain treatments, the more valuable it is. The main value depends entirely on the methods you use in obtaining those estimates. We have done the best we could to try to figure out how much is on this particular plot, and if we are not satisfied, I don't know how we are going to try to tell anybody else. We are not figuring out anything definite, so we take in five or ten or more sections of small cuts throughout the field. They are usually located as six or ten to a dozen different little plots. That will give you a pretty good estimate. We all have to consider the time that you are going to have to use short cuts when possible and of course that is what an estimate is for. They can get within certain limits of the actual yield. Now so far as other methods are concerned, we spend a great deal of time trying to get real values, as was brought out here by several of the speakers.

6. Measuring seasonal productivity - Value of pasture in terms of other feed available at the season of production and their cost - Discussion led by J. E. Foster

We have found grazing of reeds, particularly in the blackland area near the coast in North Carolina, good from about May 15 or the first of May, and the cattle make gains on these fields until about the first of August. From August until November they will probably gain less than a half-pound per day. The first cold spell late in the fall will kill the reeds and we do not have anything to graze. We bring the cow and calf out of the reeds about the last of January. We have found that continuous grazing of any tall grass will get pretty good gains.

General Discussion: This question of livestock management is important. You can be a little more lenient with beef cattle and with sheep than others, but so far as livestock is concerned, we have worked with all types of livestock. Certainly, every type of livestock must be considered together with the type of pasture to which it is going to apply. We have made some mistakes in trying to convert results given in terms of one livestock product over into another. We will have to try out the particular livestock with the pasture under test until we finally get the right answer. Our failure to do so may be one reason why we get so many different answers. The only answer that we are sure about on livestock today is the statement that a field of cotton would carry about three geese to the acre. We have been talking about pasture research for a long time and doing a whole lot of talk for the last year or so, and now we need more specific plans and developments to relate the kind of livestock to the kinds of pasture available.

We find that the early spring grasses produce milk rather abundantly, but little beef and the fall grasses produce more beef. We have a situation there that demands a considerable study in order to have the right pasture for the right animal. I believe we have beef pastures that would be quite different from dairy pastures.

We have a group of beef cattle and they are as uniform as beef cattle could possibly be. And part of those cattle last winter were carried on roughage alone and part of them were carried on roughage and some cotton seed. In other words, some cattle were fed better than others. Those cattle which received roughage alone gained a hundred pounds live weight in the first thirty days. Those cattle which had received other food gained thirty pounds in the first hundred days. In other words, the previous treatment made a tremendous difference in amount of gains which they made. If those cattle were removed from a highly fertilized pasture, it seems to me there would be a smaller gain than if they were moved from untreated pastures. So the previous treatment of the same kind of livestock makes a good deal of difference in the high gains which they make.

I have been wondering a good many times if errors in making an interpretation between the results from one animal against another animal would be any greater than our errors might be in running our experiments on a certain type of soil, and then making recommendations on that particular type soil, keeping in mind the animals which we use on that particular type. I wonder if every time we run an experiment on a particular type of soil and get certain information on that type, if we go over to another type we might make errors.

I believe that with dairy cattle we have conditions at times that we can't compare directly the yields with the two classes of animals. Beef, for example, are satisfactory livestock for a temporary period, whereas the dairy cow is not. The lactation period is relatively short and it is not going to be sacrificed by a sudden drop in that lactation period after knowing that it is very hard to get it back. I don't believe we would find the condition such that we would be willing to compare dairy cattle with those of beef cattle.

7. Small animal units - (a) Discussion led by G. E. Ritchey

I started out a number of years ago, about ten years ago, using rabbits as indicators of the value of a new grass and other herbage that we have in the nursery. We have been able to sort out two or three plants that have been unsuitable. One plant particularly that has been recommended in two or three different parts of the world as a forage and grows in Florida. On that particular plant, every time I put a rabbit on the inside of the fence, in ten to twelve days the rabbit was dead. But the idea is that rabbits

have been very successful from the standpoint of determining what you might expect. There seems to be a good deal of hesitating when somebody uses the word palatability but the readiness in which an animal will eat this grass can be pretty well determined by the use of rabbits. I have found that the use of New Zealand white rabbits give more reliable results. I have had both of them in my cages and the New Zealand seems to be more successful from that standpoint than the common. Now from the standpoint of grazing information and determining gains, with rabbits I have made little progress. The reason I haven't is because when I put the rabbits out on the grass and gave them the best of care, nothing but grass, I lost everyone of them. I can't tell you how I lost them. I did have good pasture, but I sort of felt that if you are going to raise rabbits on grass, that you are going to have to give them something else besides grass. I may be mistaken, but we may go away from the use of rabbits as a means of determining the palatability of grass for grazing.

I believe in using small animal units in nutritional work.

(b) Discussion led by H. L. Wilkins

I have had certain types of experience. I would say I am very much interested in Mr. Ritchey's remarks on the subject. My own experience has been different. We have not attempted grazing work with small animals. We have worked with harvested material. The material that we tried was primarily cut dry grass, but also used green materials in some cases. Most of the work we have done was with rabbits, guinea pigs or rats and we have run up against a very decided difficulty in this matter. The animals needing an inclusive diet of course. They just can't live on any other sort of diet. When we have come to compare two or three varieties of grass, we have to give them some supplemented feeding. And even then so far, at least, we haven't been able to measure any real difference in the grasses over all value or energy value. We have been rather interested in the use of the small animals in connection with the chemistry of the grass. Protein digestability is perhaps as satisfactory as with other animals, but of course the digestability with the carbohydrates is not. None of these small animals digest carbohydrate portions anywhere near what the sheep or cows are and it is very difficult to transpose the results over to the larger animals. And, of course, as we come to this problem, we were interested in just how these different small animals behave in their digestability. We have been rather pleased with guinea pigs. We prefer guinea pigs to rabbits partly because they eat less feed. A guinea pig will eat only a fifth as much as the New Zealand rabbit will, and when working with smaller plots of grass it is quite an advantage. It seems as though the guinea pigs digest a portion of the grass a bit better than the rabbit. We have found

it possible to cut green grass and store it in the refrigerator and keep it just above freezing and use it for feeding purposes successfully. Of course, it is not possible to get much of any gains in a small animal or rabbit inclusive diet of green grass. Once in a while, we get the animal trained to do it. Now when it comes to the question of determining some specific substance in forage, the small animals do considerably better. For instance, it is quite easy to make your vitamin determinations. And we are still making some difference in species, stage of growth, and that sort of thing which we feel will be very much worth while, and we have used it in measuring protein values.

General Discussion: In regard to cattle and rabbits, I have used both. In my test with rabbits, trying to raise rabbits on the green grass, I have had this particular trouble, not so much as the fact that they eat short, but as the fact that they get the grass all dirty and messed up and will go hungry rather than eat that dirty grass. I had to move them from one pen to another. If I am going to graze them successfully and keep the grass down, I have got to move those pens rather frequently. If I don't, the first thing I know the rabbits are sitting around wanting something to eat and they won't eat their grass that they messed up. That is just one phase from the standpoint of the rabbit. Another is that they eat certain plants right down into the ground and other plants they won't touch at all. There might be some question of management in such a study. Perhaps the plants that they eat were usually smaller.

I am wondering if they aren't placing too much stress on the use of small animals. I think they do have a place, as indicated by the discussion here. The use of small animals can only be a relative thing because of the limited consumption that you have on the capacity for these small animals as compared with the pasture herbage in an active, rapid growing condition. We are not very much interested in determining and measuring the pasture by rabbits, but rather to get indications and then taking it over to the bigger animals for measuring its products. That is what our agriculturists are interested in and, I think, we will go a little further in that direction.

We won't have to solve these problems with every other kind of livestock. Let's work with the animal that is most important and concerned with the available pasture.

Monday Afternoon Session

2:00 P.M. Room 207 Building: Daniels Hall

II. The place of supplementary feeds in pasture and range experiments

Chairman E. H. Hostetler: I appreciate this opportunity, and I think I speak for all animal husbandry workers, to be associated with agronomy folks in developing more pasture and forage for our animals to eat. Mr. LaMaster and I are going to try to see if we can't have more livestock folks in the meeting next year, and maybe we will give you a bunch of new problems to work on.

1. Effect of fertility level - (a) Discussion led by T. E. Woodward

There is no doubt about supplementary feed adding to the fertilizing ingredients of the pasture, so there is no question about the tendency to increase the level of fertility. For this reason, it would appear desirable wherever we can to avoid feeding any supplementary feed, because that just adds another factor that has to be taken care of to evaluate our results. But there are a lot of cases where a person won't think it practical to do without supplementary feed. I think probably that would be the case over most of the South. When a cow is on the pasture and she is not doing well, the practice is to give her some grain feed or some other kind of feed. It is more in line with the farm practice to give them supplementary feed that not to give supplementary feed. Where the price of the product is low they can get along without any supplementary feed very satisfactorily and still be in line with the farm practice. Now then, a cow giving twenty-five pounds of milk a day for one hundred and eighty days will secrete five pounds of calcium, four pounds of phosphorous, and twenty-five-pounds of nitrogen, and seven pounds of potassium in the milk in the course of the season. Twenty-five pounds of milk a day for one hundred and eighty days is equivalent to a considerable amount of fertilizer. That is just what is removed in milk. That four pounds of phosphorous is equal to about sixty pounds of sixteen percent super-phosphate, twenty-five pounds of nitrogen would be about one hundred and sixty pounds of nitrate of soda. Now then, if the cow is going to remove that much in the milk through the season, it is very evident that unless something is done to put an equivalent amount of those ingredients back in the soil the pasture will be depleted. But carrying away the fertilizing ingredient in the form of milk isn't the only way that they are depleted. The cow is off the pasture, we will say, about four hours a day. That means that one-sixth of the time she is off the pasture, and about one-sixth of that manure is deposited somewhere other than in the pasture. A cow migrates around shade trees and around gates, and for that reason the manure isn't uniformly distributed. Another thing we have found is they prefer to bed down where the grass is tall. They like a soft bed the same as we do, and naturally more manure

is deposited there than on the places where the grass is shorter. The tendency then is for that pasture to become more and more un-uniform. Now then, I have been trying to figure out how much supplementary feed we would have to give a cow so that the fertility level would be maintained but I am not too sure that I have figured it out just right. But anyway, when a cow eats a hundred pounds of grass, assuming she will eat that much a day, and gives twenty-five pounds of milk, one-eighth of the calcium that she takes in goes into the milk. That is on the basis of southern pasture grasses gotten from Morrison's book, giving the analysis. I haven't got phosphorous figured out here; one-fourth of the nitrogen and one-eighteenth of the potash. If the cow takes in a hundred pounds of grass a day and gives twenty-five pounds of milk, there is that proportion of those fertilizing ingredients that are put into the milk. Then if we add to these the one-sixth of the manure which is dropped somewhere besides the pasture, and when you take into account the lack of uniformity that that manure is distributed, we would have to add about a half as much fertilizing ingredients as there is in the pasture. That is only a rough guess. Now then, how much supplementary feed would it take to add the fertilizing ingredients that she takes out of the pasture? Now, if she eats a hundred pounds of grass a day in the form of milk and otherwise and if the green mixture is composed of three parts by way of corn, and two of oats and one of cottonseed meal, she would have to eat one hundred and seventy pounds of supplementary feed to furnish the calcium. She would have to eat twenty pounds to furnish the phosphorous. She would have to eat twelve pounds to furnish the nitrogen and fifty pounds or more to supply the potassium. Well, that just shows that because of the quantities that are required to go along with the grass that it is more than farmers are going to feed or investigators are likely to feed, and then if we are to maintain the fertility of that soil theoretically, we will have to use some fertilizers or manure or both. Otherwise the fertility is going to decline.

Chairman: That is very interesting. Are there any questions you would like to ask Dr. Woodward while he is still up here?

McKee: Do you have to put back as much as you take out?

Woodward: I would leave that up to you soil men. I don't think you need to pay much attention to the nitrogen part because we know we may have a lot of it in the fall and very little the next spring.

Burton: How much of those minerals could a mineral mixture supply? What percentage of what the cow require can be supplied in that form? That might be the cheapest way to supply it.

Woodward: That is a possibility I didn't figure on and it will take just a little book work to find out. I rather suspect that it would be in the phosphorous. I hadn't figured on the amounts that might go out from the skeleton. You take the amount of milk. The cow goes up to the barn lot. There is some waste in there, isn't it? And when the same manure gets back on the pasture or the field there is some waste on the field.

Lush: Then you should figure more going out than coming back. You can't possibly get as much back as you take out.

Woodward: There won't be much in the skeleton. However, there had been about four to five pounds of phosphorous annually in milk. You might replace that with a bone meal to answer that other question, but you could hardly feed potash back to the animal. You might feed nitrogen back to the animal in the form of protein feeds about two and nine-tenths times as expensive as putting it back another way. A person could feed a lot of that potash as roughage rather than with grain.

(b) Discussion led by R. H. Lush

I thought I would attack this same problem from just a little different angle than Mr. Woodward to the end that the cow is taking more out of the pasture than we can possibly put into the pasture, and we can't create it from outside by increased grazing, etc. It would never get back if we don't have proper fertilization. We get a net loss of plant food legumes around ten pounds of nitrogen, twenty-four and three tenths of $P_2O_5$, and twenty-five of potash. Actually, the crops that remove the least from the soil are some of these crops like cotton which we don't consider as grazing crops and are only used for a few weeks in the South. And we figure the losses that livestock have in manure, fermentation losses, leaching, wastage, poor practice, poor management returns, why, I think the amount lost from any of those fields must be fully as great as Mr. Woodward has expressed it, or possibly even greater.

Seath: Mr. Chairman, I am wondering if others have had the experience we have had on some of these experiments when our check lots are fed grain quite heavily. When they are fed grain the cattle improve as well as on the fertilized pasture. Many of our check pastures improved, not to the same degree, but have improved some from year to year due to the manure from supplementary feeding.

2. Effect of changes in flora - (a) Discussion led by R. L. Lovvorn

We will discuss for a few minutes the relationship between change of vegetation and supplementary pasture. We know that the resulting vegetation does depend to a large extent upon management, that is intensity of grazing or earliness or whatever type of management that may be practiced. Just this spring, particularly in western North Carolina, we found over grazing at its worst so far as we think of it in the humid region. We have some intensity of mowing plots in that area. On plots cut back to a height of a half inch every month, we had a unit of two hundred strikes per plot using the inclined point quadrat as our method of counting. By raising our mower up to an inch, which so far as the average farmer is concerned is not close grazing, the count was increased to 400. The simple illustration of those two treatments show that our density was twice as great under one as it was under the other. In addition to the fact that we had twice as much vegetation at one inch as we did at one-half inch, the percentage of weeds was about twenty-five at 1 inch, and at one-half inch it was about fifty. You can see the part that supplementary pastures must play in any permanent pasture system. The only way we are ever going to get around over grazing is the supplementary pastures It comes in from a mangement standpoint and has to be part of the investigational program.

Fippin: Mr. Chairman, I would like to ask a question or two in case of these problems. When it comes back to this problem of fertility, is our first obstacle to meet the needs of the crops, or is it to meet the deficiency of the soil? Any particular plant has certain uniform characteristics wherever they are grown but the soils do differ. They are like a picket fence with different heights of pickets and when those pickets are up to uniform fertility level, we have what we call a fertile soil. Now our fertilizer problem is to determine the types of deficiency or the ratio or how much they are deficient, and that determination is a characteristic of that soil. Corn, wheat, and clover or that type of rotation basically also applies to the pasture when we talk about fertilizing pastures. So I am always rather questioning in my mind the distinction from other rotations. I am wondering if our first fundamental problem isn't to get at the basic need in abstract terms and then adapt it to the particular type of problem we are facing. Of course, we recognize that the animals are running over that land. Let it be added to the basic needs. The other question is this - We know in our ordinary crops that under any given uniform fertility condition of the soil, corn won't need as much nitrogen and phosphorous as a crop like wheat will, because it has a bigger root system. It seems to have a little bit better ability to get those. Wheat takes a lot of phosphorous and it seems to have a little difficulty to get it. So it responds especially to that. There are those differences and now we know those more or less, I am wondering whether in this pasture problem if we do not need to determine the absolute characteristics of these pasture plants.

The amount of attention is being given to determine the absolute characteristics of those pasture plants grown alone. If we grow our mixed group, why, we have a composite and different demand. Their reaction will in turn depend upon the characteristic limitation of that soil and the fertilizer we are using, but if we knew the characteristic of those plants determined abstractly, then we could begin to put these together, it seems to me in a more intelligent pattern. More fundamental abstract studies of these individual pasture plants that we are trying to put together are needed.

Aamodt: There is just one thing I had in mind. Mr. Fippin brought out very clearly that there is a need for understanding the growth habits and characteristics of individual plants or plant species. That is true, of course, in our understanding of production problems with crops that we grow as pure crops like wheat, corn, cotton, and tobacco, but in most of our pasture and forage crops we are concerned with mixtures or plant associations. I would like to point out that there are certain root interactions and antagonisms that make the performance of a plant entirely different from what it does when they are growing alone. What is the value of an intensive detailed study of plants in pure culture if they react differently when grown in mixtures. There are many illustrations I could give. I shall give just one on how to evaluate individual or new strains of grasses and legumes. In a pasture containing several grasses, bluegrass, redtop and Timothy, and three legumes, white clover, red clover and alsike, there were quack grass patches from previous infestations. In the quack grass patches there was no white clover. The white clover would come along right up to the quack grass and would stop, but the red clover and alsike were in there. Something in the quack grass did inhibit the development or eliminate the white clover. I just felt that this idea should be brought in here. In our pasture and forage work there is a need for a more thorough consideration of associations rather than individual plants. I am hoping that it will be discussed more thoroughly tomorrow morning.

Chairman: There is no doubt about that. We are certainly interested in combinations of grass used.

Fippin: May I just put in a word, not in contradiction to what Dr. Aamodt said, but I wonder if the scientific approach doesn't require first of all to learn the individual characteristics of the plant and then those antagonisms. Does it vary from soil to soil? I wonder if you get any definite information working on the study of masses of that sort. Any useful information, I am sure I don't know, but we need it. We certainly do need it.

Chairman: Are there other questions?

Rankin: I want to point right along that line something Dr. Sell brought out the point this morning that Bermuda grass growing in association with lespedeza than Bermuda growing alone. I wonder if he would like to amplify on that statement.

Sell: I had a little information on Bermuda grass, only enough to emphasize that we do not have enough analyses of grasses growing in association with lespedeza. I would like to mention a way of approaching the study of individual species mentioned earlier. We find that phosphorus in the soil outlines the white clover in the field and that white clover has a high phosphorous requirement. We have not studied them by themselves.

(b) Discussion Led by J. L. Stephens

I am so confused I don't have anything to say after all these questions. I am just afraid I will be shot at when I get through. When you get so confused after hearing so many questions about problems of pasture work, the only shining light and guiding star is that you only have to use judgment or common sense that we have one thing that we are striving to do. In other words, we have to increase our grazing capacity per acre, or milk, or whatever we have. Now the change of flora is just one of the problems that come up, or the one among the many. Floral changes, both in the pasture grasses and legumes, and also in the weeds as they come in the pasture according to the time of planting, mowing, and management. Now in regard to weeds in a pasture. When I say weeds, I mean those we haven't planted or don't want. We will just divide them into two, those that are not palatable and those that are palatable. Now in the permanent lowland pasture, you will find those that are not palatable. They come in at different rates. As your fertility increases, or over a period of years, you will find that some perennial weeds will come in and be a very serious problem. Others are the rushes and sedges. We can control the palatable weeds and unpalatable weeds by our method of management. You can mow but you have to follow through and do a lot of hand mowing to get rid of the rushes and sedges. I don't have any answer for those. Heavy grazing will tend to it, especially early in the season. Now in the upland pastures it is a little more simple. They are controlled by plowing the Bermuda pasture every three years. Plowing will run out species that are predominantly unpalatable, and will then bring in species that are palatable. So we believe that management problems are one of the reasons why we haven't been getting grazing that we should from lowland pastures and upland pastures in the southern part of the State of Georgia. And that brings us one thing in favor of annual temporary pastures in the South. You can control your weeds and cultivate your crops and get away from perennial and other unpalatable types of plants.

3. Calculations of feed equivalent in supplements

Discussion led by J. P. LaMaster

In production we have certain overhead charges for labor, barn care, and management; and breeding of cattle that must be paid for from the milk. They must give in sufficient quantity to pay for the overhead charges to make a profit. So one of those overhead charges is the maintenance of the cow every day in the year. You must also pay for these other items plus the supplies and all those things. So for each farm there can be calculated the volume of milk which is necessary to make a certain amount of profits and pay for those overhead cares. A cow's production curve works something like this: (Illustration) The higher they grow, the faster they fall. A cow freshens here and increases this production for about six weeks, and then she goes for eight months or thereabout at a level of production which is of uniform rate. That line is straight and it varies with the management of feed conditions. We have accepted the two and a half percent drop per week or a little over ten percent per month as being our standard. Now these can be divided into months or periods here. And you will get from these cows nine hundred pounds here and one hundred and ten pounds here and so on down in order to maintain her capacity to produce. This drop is physiological, you cannot prevent it. You can get production on up in this range and then they may get so poor that they may drop down to this range. It is easier to go up from here than it is after you get this far down. So where the necessity of knowing these situations, of getting back as much as you put in management and breeding of your cows. And we have variations in the yield and composition of the grasses as we do have that in many cases they drop on down in this area and feed just a small amount of supplementary feed and follow along that line to get a possible flow of milk. In estimating the returns from a pasture, it would be ideal to eliminate supplementary feeding entirely for the following reasons. Heavy feeding of supplementary food increases the return of plant feed to the pasture. This is a very important factor when attempts are being made to attain full information of fertilizer treatment. They may be obscured by the supplemental feeding. This is an important factor in determining different pasture grasses or mixtures. Supplemental feeding complicates the calculation of yields. Information provided in supplementary feedings are the amount of feed fed. In the case of a milk cow, it is almost always necessary to supplement with barn feeding. To maintain a rate of milk flow to prevent drastic changes due to shortage of pasture. The next point is the nature of supplementary barn feeding. That the rations be as simple as possible. The concentrated mixture should be used if possible, and its advantages over roughage are uniformity of composition, ease of weighing readily and completely consumed provide needed energy without burdening the capacity of the cow which may already be full of succulent grasses. In order not to obscure the effects of pasture, concentrate should consist of feeds low in minerals and in protein but high in energy. Second, protein content may be varied

according to the composition of the pasture. Third, concentrate mixture should be standardized, generally to that recommended for the section where the work is being done. Where the supplementary feeding is roughage they may be fed in very moderate amounts. Otherwise, they would inhibit consummation of pasture grass because it would fill the cow up so. We have found that one of the best supplements for pasture is beet pulp. Uniform in composition, it is relatively very easty to handle, it is palatable, and usually all of it is consumed and it is essentially a source of energy, very little protein in beet pulp. Hay and the difficulty of maintaining uniformity in the consummation or in the quality of these two products is very evident. It is very difficult to measure the consummation accurately because the cows will refuse hay. They will eat the leafy part and leave the stemmy part. What they leave is different in composition from what they eat. If a pasture is sufficiently deficient in that it is to require the feeding of hay and silage for normal production, it is probably better to remove the cattle from those pastures to get your normal production on those yields. Your next point is the inter-relationship and the pasture herbage of the supplementary feed remains an unknown factor in calculating pasture digestability of feeds. This is likely to be an uncontrollable factor varying with seasonal changes as well as with different pastures. In recording yields of pastures, the class and quality of supplementary rations should constitute an important part of the expressed results. Not only in quantity but the analysis of those feeds and the periods covering them. As yet, the economy and physiological use of supplementary feeds have not been determined in relation to pasture. This problem with dairy cattle is quite different from that with the beef cattle, and I think maybe the agronomist would prefer to deal with beef cattle, but he might remember that that data will have limited application to the dairy cattle after he gets it, so if he desires to get his information on the value of pasture production, I doubt whether he could put a bunch of yearlings out and let them graze it and then add up his results and say that is what this pasture is worth. We have not only the problem of the pasture, but also the supplementary feed which is the subject under discussion and which is absolutely a necessity in this country because all your clipping work will show pasture plants vary tremendously in composition about up to sixty percent dry matter from protein content up to twenty-five and thirty percent and on down to ten and fifteen percent. And your yield, you know what we have gone through in this drought, nothing up to a tremendous amount. So we have those variations which must be considered as being practical phases of this problem for dairy cattle. And we cannot turn our dairy cattle out on the pasture and bring them to the barn in the morning and milk them and call it a day.

Chairman: Thank you, Mr. LeMaster. Are there any questions you want to ask the gentleman? This is one problem that we are right smack up against in this pasture work in evaluating these pastures with different animals. Certainly the dairy cow is one that raises many problems more than any other class of animals unless it is hogs, certainly more than beef cattle or sheep. Are there any more questions or any more analyses?

Blaser: In the discussion of supplementary feeds, there has been one thing that has been omitted. Nothing has been said about supplementary pastures except in more or less an incidental way. These supplementary pastures are provided with annual plants. Annual plants are quite expensive. Sometimes the seeds will cost five to six dollars an acre to plant. And you have to in some cases cultivate them and then you need them very often for a period of a few weeks and won't need them for another series of weeks. We have found that for experimental work it is better to provide other types of feed, however, on a practical basis. There is quite a bit of that supplementary pasture being worked with, and I think that if anything is done in the way of providing supplementary pastures some perennial plant is more practical than an annual plant which has to be planted each season because of the cost.

Lush: I don't want anyone to have the feeling of one man, who probably knows the South as well as anyone, who wrote me some weeks ago that this dry season emphasized putting more time on supplementary grazing crops. Some years ago I asked a man this foolish question: What is the best kind of pasture? And he gave me a foolish answer. He says it is a half acre pasture you don't need. And yet it was the best answer I have ever received. I might say the same thing in the pasture program, it is the supplementary pasture that you may need that is the most important link in the whole program, particularly for dairy farming, for hogs, for getting the most out of beef and as they mentioned this morning in poultry, it is entirely supplementary. There is a feeling in some of the States, take Missouri for instance, Dr. Brown released correct information the other day, stating that they have obtained twice the day's grazing from the wheat and lespedeza than from good bluegrass pasture for an average of four years, and that has been shown again and again in different places. We get an enormous amount of feed produced in supplemental crops that comes in at an extremely valuable time. Now, the point I was trying to make was that the supplementary crop is a heavy feeder because it is a heavy producer, and if we get that heavy production, we may be taking a great deal out. To be successful in farm management it has to be milk cows on some pretty good piece of land close to the permanent pasture, so they will be alternating in the grazing system rather above average land. I think, therefore, we are inclined to believe we get more. One extension man in one of the Southern States who says that we are going rapidly to a supplemental grazing program because it uses the best land. If it were measured on a certain

basis it might not be true. The work, I think, indicates that is done. However, he may be entirely right about that. But we can't get along without that extra bit of feed. The research program will have to emphasize supplementary grazing crops. Compare them on the same kind of land with as nearly the same type of conditions.

Cox: I have one statement to make. I want to say in our experience at Wilkesville in that these temporary pasture crops are expensive. And that means you have to plow and seed, etc. every year. Now then, I am in favor of these supplementary pastures, but it should be something that you don't have to seed every year. For instance, the lespedeza this time of year in some places, the alfalfa for some places, the aftermath from hay fields. I am all in favor of those, but I just can't see these annual pastures whether it is Sudan or whether it is soybeans. Another thing we don't get near the yield either from the Sudan or from soybeans that we get from them in the form of hay, something like a third.

Chairman: Thank you. The other statement is this. We never take our cows off our Bermuda pastures. There is always a cow to the acre left on those pastures and they are always getting something there this spring and every other spring and they will do like one gentleman mentioned today. Their noses are always dirty during the dry periods. They are eating the stems down under the ground because the grass is not coming out of the ground and they are getting something.

LaMaster: Mr. Chariman, a few minutes ago you mentioned that we were getting into a different angle in this supplementary pasture as different as the supplementary feeds and I'd just like to come back to our discussion. One is production program, and the other is the experimental programs for trying to evaluate a particular pasture in the production program. Not that we don't need the discussion at all on the production program, but let's assume that that might be an alternative method for measuring. Could we measure it as well with the supplementary pasture as we could with a supplementary feed. Thinking of the concentration it would seem to me the supplementary feed would be more reliable over a period of years or through a season if we depend on the supplementary pasture. The whole picture might be changed according to the stage of growth by the plant. But your supplementary feed would probably be about the same whether it be spring or summer or fall, so it is sort of a basis toward which you can check the productivity of your experimental pasture. It seems to me that would be much better as a supplementary feed. It seems to me you get into a lot of complications when you are evaluating an experimental pasture. I hope that is not too complicated, but there is a relative difference there as I see it. I appreciate it because we, as I mentioned, did get off the subject of how these supplementary feeds affect these pastures and how we are going to evaluate them.

4. Forest-Range problems - (a) Discussion Led by H. H. Biswell

Last spring I made a survey in southern Georgia to find out just what extent forest lands or pastures were being used in raising beef cattle, and what the main problems were in using the forest land and vegetation. The main grass there, as most of you know, is wire grass. The cattle begin to graze on some of the new feed along about the first of April. Gains are comparatively good, very well up to the first of October. Then the gains begin to fall off. During October, November, and December they fall gradually, but during January and February they may fall off very fast. In this survey we interviewed 106 farmers. Twenty-one of them were feeding their cattle on this forest range alone. Others were grazing from the first of March to the first of October. Now, when these cattle were off pasture they were supplemented by various means. Of those that kept their animals on the forest pastures a year long, ten of them supplemented, and for the eighty-five that made seasonable use of it, twenty of them supplemented. The remainder of them used no supplements at all during the time they were on the forest pastures. Well those that did use supplements on the forest pastures used mostly straw and other roughage and they explained that supplementary feeding on the forest because the cattle would not eat enough roughage otherwise. In no case did we find anyone supplementing with a concentrated meal, as cottonseed, peanuts, or things of that nature. The calf crop here we found to be very low, and the lower coastal plain around 71 percent. One survey was made to find out just what are the main problems and for other problems besides use of supplementary feeds. The use of minerals and so forth have to do with the use of controlled grazing on land. We found that of the 106 farmers interviewed, about half of them were practicing burning at the present time, most all of those every two or three years. The main reasons for burning are to insure against devastating fires, burning to control brush, burning to improve forage. There is a problem of determining grazing practices, forest management, improved pastures and finally, of course, of determining economic raising of cattle.

(b) Discussion Led by J. E. Foster

Last year a survey was started in the coastal plain area of North Carolina to determine what extent forest ranges were being used for beef production. We don't wish to get into an argument with the forestry people about the advisability of grazing in the mountains or Piedmont area, but in the coastal plains where the trees are mostly pines, there might be an entirely different situation. The object of this survey was not to determine how poeple could make the most out of their timber from the timber standpoint, neither was it to try to determine from the beef standpoint; but how they could make the most out of the total income from the forest. We have many cases where they could get a greater income by a combination of good forest factors accompanied by controlled grazing for beef cattle. In this

survey we found many problems upon some of which we think we can give some light, and others probably are too complex to be able to solve any time soon. In these forty-four counties we interviewed the owners of one hundred herds. There are fifteen million acres of land in this areaand 64 percent is in forest. Seventy-five percent of the people that were interviewed were planning their forest range in such a way as to use it for both timber and beef. Our greatest single problem was the control of forest fires. The cattle men were unanimous in their opinion that grazing forest range greatly reduced the fire level 25 to 100 percent to an average of 60 percent reduction. An average of these one hundred, grazing made up approximately 27 percent of the entire feed for the year. The particular type of this range that we paid more attention to was the reed type that offers the most promise. These reeds furnish considerable grazing and put on reasonably good gain during certain seasons of the year. Most of the men were using their forest range grazing during the summer, although we found a few of them that were using it the entire year and some of them were using it just in the winter. The supplementary feed did enter into the problem there, but that was one of our chief problems. Lespedeza was playing a very important part according to this survey both as a hay crop and as a pasture crop, and it was being used as a supplement, or you might put it the other way around, the forest range was being used as a supplement to the lespedeza. You don't count on lespedeza much before about June unless these men were carrying their cattle into the forest in April and putting them out on lespedeza. But anyway, the winter forest was the greatest problem from along about the latter part of January on out to the middle of April, the critical time of the year. We have some problems there which we hope to at least get some idea on in the next few years and what the land will do. In this survey we found all the way from complete supplements to where they were not supplementing any other feed. Where they were not supplementing any the calf crops were dropping down to forty percent and the death losses were pretty high. Additional information in the past indicates sometimes that two acres of good stand of reeds would carry a cow and calf from May until November. They produce satisfactory gains from May to August, after that it is maintenance ration until November, and then a new area that has not been grazed will furnish pretty good wintering up to calf time. By running cattle on this timber he can get a little bit each year of timber until its optimum state of maturity. Looks like that is a well worth while problem.

Cox: About the calf percentage and the calf crop, what is that due to, phosphorus deficiency or some other cause?

Biswell: Well, I don't know exactly, but probably in some cases at least it is due to the malnutrition in general, and in other cases we think it is definitely due to mineral deficiency. We have some indications at least that we have got cobalt deficiency in certain sections of this State, but it doesn't say that was responsible for the

low calf crop. We have some of the same sort of cattle that have the same conditions. I think it is primarily that they just can not get enough feed, but we do believe now that we have indications that there are certain mineral deficiencies that need to be supplemented.

## Monday Evening Session

7:30 P.M. Room 207 Building: Daniels Hall

### III. General discussion on breeding technic for forage crops

Chairman H. R. Albrecht - This evening those of us who are primarily responsible for the breeding programs are particularly interested in having the animal husbandry men, fertility men, as well as agronomists and others, give us their ideas on what sorts of grassland plants are needed in the Southeastern Region. We have certain ideas in our own minds. You have some in yours; we've got to find out how to get them together. First, I'd like to call on Mr. Spencer to give us an idea of the way in which a plant breeder sets out to do the job from the standpoint of the breeding program.

1. Technics (selfing and hybridization). Time-saving methods or devices

Discussion Led by J. T. Spencer

First of all, I think it's obvious that this subject is a very extensive one, and as I see it one man can do only a small part of it. I suppose from the topic that I am to discuss specific objectives. We're assuming that the plant breeder also has some broad objectives. I think we can state that the broadest object is the selection of grasses for adaptation, that is, selection for adaptaion to some particular locality. I suppose that any grass breeder has little difficulty in visualizing the ideal strain of any species that he's working with. Nevertheless, the problem is a very complex one. We're breaking that problem down into a simpler one by choosing very specific objectives. In Kentucky, we're working with two grasses, Kentucky bluegrass and Orchard grass. Our breeding programs are very young. We are still primarily in the collection phase. We are collecting as much material as possible of both species and setting that material out as individual plants in the nursery. That seems to me to be the best way of handling those plants. Now we must have some criterion by which we may discard most of these plants. And it's those criteria that I should like to say something about. So far, it seems to us that selection for disease resistance is the primary objective. Unfortunately, with Kentucky bluegrass, we do not get many reports from farmers on the distribution of various diseases. I think that's primarily because the grass leaves are small and most people fail to observe the diseases which do occur. I am not a pathologist, but I

am working in close cooperation with the pathologists on grass breeding programs. The main disease, that is, the disease that seems to be the most serious and most widespread on Kentucky bluegrass is the leaf spot, probably more than one leaf spot. These diseases are widespread throughout the bluegrass region in Kentucky. Another disease that occurs, not as extensively as the leaf spot, but rather frequently, is the leaf rust. Occasionally individual plants in our nurseries are very seriously affected with leaf rust; there is another problem in selecting plants of resistance to that disease. During the spring of 1940, Mr. Henson and I visited a great many pastures throughout the bluegrass region in central Kentucky. We were much surprised to find that leaf smut was a very serious disease, we classify it as occurring in epidemic proportions. The diseases of orchard grasses will be considered. I might summarize this by saying that my primary object is the improvement of the Kentucky bluegrass by the selection of strains resistant to the leaf spots and the leaf rust. We have a local situation in Kentucky that is influencing our breeding investigations. The bluegrass seed industry has sustained severe reverses for the past four or five years. In fact, many of the bluegrass seed collectors, I won't say many, but two or three are going out of business. The productions in seed yields amounted to about two-thirds of former yields. That is, compared with the yields obtained about two or three to five years ago. That means that we must add another objective to the breeding program. This involves determining seeding abilities of our various individual bluegrass plants. We haven't developed a technic yet. Probably someone has suggestions along that line. Now, of course, there are other specific objectives. In the bluegrass breeding program, I'm thinking first of all of the determination of herbage yield. I think that's rather difficult to solve in a nursery. I think that is one of the characteristics to be determined as early as possible in the breeding program. Another characteristic that we must try to work on in Kentucky bluegrass is its susceptibility to hot, dry weather. This year produced a very good illustration of what happens to that grass. Generally, May and June, especially May, are very cool in central Kentucky and there is abundant rainfall, but this year it was very dry and hot. Throughout the region, during that time it looked very much like August. At any rate, that's just an illustration of how in a short period of hot, dry weather, Kentucky bluegrass grew brown rapidly. I think that's definitely one characteristic that must be considered. I'd just like to summarize: Trying to improve the Kentucky bluegrass, first I think the most important is resistance to leaf spot. Then other important objectives are the determination of the seeding ability of herbage yields, determination of tolerance to drought of the various plants that we have. Now, just a word about orchard grass. I'm going to say that our primary objective is the selection of a strain with heat resistance. There are also very serious diseases, such as various leaf spots.

Chairman: We may gather from Dr. Spencer's remarks just about the way in which plant breeders think of the objectives in our work. In other words, we consider factors such as disease resistance, and yields, and a number of other things of that type in working with the particular species and combinations of species. We've got to know first of all with what type of forage we are working. Some plants are short and others are tall. Management has a lot to do with that. Dr. Porter, an experimenter with animal diseases has conducted some trials in two lots, one which was not very heavily grazed, had an abundance of vegetation, in the other was kept short with a lawn mower. The incidence of parasite infestation was far greater in those animals which grazed the tall growth than in those animals which grazed the short growth. At one stage of the life histories the alternative host species climbs up on the herbage and deposits its eggs; it is able to do this much more effectively in tall grass than on short. We very seldom think of pasture work as a means of solving pasture sanitation. The association between the high herbage and parasite infestation in Dr. Porter's work is not conclusive yet, but he had a fine demonstration in the spring. I'd like to call on Dr. Neel from Tennessee to give us some ideas about some of these objectives.

Neel: I'm afraid I can't make a contribution on that. My work is not in technical lines. We have to plant things in big fields, and I can't give so much time to this sort of thing. However, I'm very much interested in the work which Dr. Spencer is doing. That work in orchard grass for longevity is important for orchard grass does not produce a long-time pasture. I might say this about our pasture work. I tell my agronomist that we have two grasses. We must build our pasture around those. They are Bermuda and bluegrass. We usually have Bermuda, a little patch here and a little patch here. The Bermuda doesn't do much good that way. I don't try to urge it on the farmers. If they can get bluegrass, they don't want Bermuda. Further south there are Bermuda, Dallis and Carpet grasses to build around.

Burton: I was speaking about this objective pertaining to disease resistance. One point was brought up last year by some of the men. We have a need of forage for dry periods. We have a need for supplemental pastures. We don't know exactly when we're going to need them. We may use them one time and again we may not need them at all. What we need, in my opinion, is grasses that remain palatable even when they are more or less mature. Some of the hay type Bermudas remain vegetative over a long period of time. We may graze them closely or keep them entirely ungrazed. Consequently we always have a reserve of forage. Graze at 10 inches and if a dry period comes along we have them utilized. We haven't proven all of it but it sounds reasonable at least. As far as our objectives are concerned, they are similar to those of the other grass breeders.

The diseases are a serious problem. In Sudan grass, for instance, we have found six different foliage diseases. Bacteria is not quite so serious as the three fungus diseases. We are trying to get disease resistance.

Ritchey: One objective which I think hasn't been mentioned, which I consider important, is the breeding for palatability. We know that the leaf and vegetative part of the plant is not only more palatable, but more nutritious. And we can get either leafy or stemmy plants.

2. Heterozygous versus homozygous selections

Chairman: The next topic on this program is the technique of selfing and hybridization. Tonight we have Dr. Myers of the Regional Pasture Research Laboratory, and I wish to call on him to open this discussion.

(a) Discussion Led by Will M. Myers

I wish to mention a few of the high spots and spend some of my time on the work that we're doing at the Research Laboratory, and perhaps you will be willing to come back and say a little bit about what you're doing. I'll attempt to report a few of the things that have come to my attention. Let's take them up by considering the technics involved in self-pollination first. A number of methods have been used. These include space isolation, either in the field or in the greenhouse, the use of cloth cages, or cloth sleeves, to cover the entire plant, or the inflorescence, and the use of paper bags to cover the inflorescence, or paper sleeves for the same purpose. I will not dwell very much on some of those because they are used in rather limited ways. There is one very serious disadvantage in space isolation, and that is the number of plants which can be handled by such a method. I don't know what the distance with space isolation would be. It would vary a lot with different species. With species which occur in the region, naturally, it would become practically an impossibility. The only use that the method has, as nearly as I can see, is that space isolation is the only criterion that we have for the self-fertility of a particular plant. Any other method that we use imposes artificial environmental conditions upon the panicles or upon the soil and adversely affects the seed set. We are interested in the ability of set seed under the conditions of protection from foreign pollen, which we're using. I'm mentioning the isolation method because I think that it has the advantage over results from other methods of isolation in which we are not dealing with true seed setting ability but instead with ability to set seed under the conditions of isolation. In the greenhouse it is in some ways more simple. We can then control moisture, light and temperature conditions. The number of plants which can be isolated is again limited

by the space available. So again it is not a practical method except for very restricted studies. The use of cloth cages was more common a number of years ago; in fact, I believe that almost everybody who has self-pollinated grasses has used, at some time or other, cloth cages. They have some advantages, particularly in that the seed set under a cloth cage is better than the seed set under a paper bag, because the environmental conditions are not quite as adverse under a cage as under bags. The cloth has been found satisfactory in one of a very high thread number so that the threads are particularly close together and there is not much chance of the pollen seeping through. It is very difficult to obtain. We turned down one consignment of cloth after another until eventually we gave up in despair, because it didn't seem possible to get the specifications that we called for. The number of plants which can be isolated by cloth cages is also rather limited. That is, we cannot put out thousands of cages in our fields each year with the facilities that most of us have available. When cloth cages are used, all uncaged plants in the field should be cut in order to reduce the amount of pollen that might seep in from the outside. When all the plants in the field which are flowering are covered, there is relatively little chance of pollen getting from one cage to another. Cloth sleeves have been used, but they have one rather serious disadvantage, I believe, and that is they don't give complete isolation because of the difficulty of getting cloth pollen will not pass. By far the most common method of self-pollination in the grasses is by the use of some type of paper bag. This may be a Kraft bag, or a glassine envelop, but I think that most workers use parchment bags. The parchment bags have the advantage of toughness. They have another great advantage over the other types of bags which we have used in that a large number of bags can be applied by a single worker. When we use bags we must remember that we are not studying self-fertility. We are studying the ability of the plant to set seed under bag. For practical breeding purposes, if we are planning to use bags, that is the critical thing that we need to know anyway. Our method of bagging at the laboratory is probably very similar to the method used in a number of other places. We use, as a label, the copper wired wooden tree labels. They may be obtained from any seed supply company. On this wooden tree label, we list the number of the plant and any other pertinent data. We use a vegetable parchment bag 12½ inches by 4¾ inches. We place a paper clip on the corner of the bag to give us a method of anchoring the bag. A stake is put in beside the plant. The bag is placed over four heads. We have selected four as the most satisfactory number of heads of panicles; we merely crush the bottom of the bag together, put the copper wire around the bag and twist it two or three times to hold. We then tie the bag to the stake with string, and that is all there is to the bagging operation. Cotton has been used by more than there are those who do not use it. We do not use cotton because we have found no advantage in using it. Furthermore, we have checked out method by the use of male plants carrying genetic markers and we

do not find evidence of cross-pollination. I might say something about harvesting these bagged heads. When harvesting, we cut the stems and leave the label with its wire on the bag until we are ready for threshing. The panicles are not taken out of the bag until time of threshing. It saves considerable time in the operation of harvesting.

I might describe a little of the technique which has been used at the Laboratory for selfing clovers. Dr. Atwood uses a small bag for the purpose of preventing insects from reaching the flowers. In some species it is necessary to trip each flower with some sharp pointed instrument, but with white clover it is merely necessary to rub the heads gently between the fingers without removing the bag. It has been found that the flowers open over about a six-day period and with two manipulations usually on about the third and sixth days as good a seed set is obtained as with more frequent manipulations. The techniques of cross pollination are now to be briefly discussed. In various species we have a considerable amount of self-sterility or at least inability to set seed under bag with their own pollen. It is a very simple process to place two heads of different plants that will not set seed under bag with their own pollen, in the same bag. We do our hybridization work entirely in the greenhouse and when we wish to cross two strains, each of which is self sterile or unable to set selfed seed under bag, we obtain our cross seed by bagging two hundred or more pairs of the combinations we wish to obtain. With partly or completely self-fertile plants it is necessary to resort to emasculation. Hand emasculation is relatively easy with large flowered species, but it is a rather prohibitive job to get very many hybrid seeds in this way from Kentucky bluegrass.

A method was devised by Stephens and Quinby in 1933 with the sorghums involving the use of hot water. The emasculation method consists of immersing the entire head in hot or warm water, at a certain temperature for a prescribed length of time. A considerable amount of work has been done and published data are available on this method. For various of our forage species the required time and temperature have been studied. I'll say this much about our results, in which orchard grass was studied particularly, the critical temperature range is extremely narrow. If the temperature drops too low, some selfed seed are produced; if the temperature is slightly higher, the whole panicle will be killed. It is a rather delicate and critical job. In orchard grass we had worked out the exact temperature we planned to use. Then we used that temperature and killed every panicle we treated in the greenhouse.

For the hybridization of the legumes the use of suction for the removal of the anthers of sweet clover is quite successful. Dr. Atwood uses a vacuum pump and is able to suck the anthers off, and apparently if he works the capillary tube around over the stigma the pollen is removed so that he doesn't have any trouble. There is one

thing he would have wanted to have pointed out, that with self-incompatible plants there is not critical test of whether emasculation is complete for the pollination. He pollinates ten flowers on a head.

Another method of emasculation which has been used with the legumes is the use of ethyl alcohol. The entire inflorescence is dipped in; I believe fifty-seven percent of ethyl alcohol for ten minutes is recommended. The flower is then immediately dipped into water. Apparently it is a rather successful method.

The only other method that has been used that I would like to mention is pollination with bees. It is used with self-incompatible plants. These can be placed together in a cage and the bees turned into the cage to make the crosses. Honey bees are used by setting a hive so that the bees have access to the cage in rather large quantities. At some institutions the bees are washed to get rid of the pollen. Atwood has found with his work that if the bees are isolated 24 hours before being released into the cage, they are free of foreign pollen and no contamination occurs.

(b) Discussion Led by Ben W. Smith

I. In the improvement of any forage grass or legume by breeding, the procedure to be followed depends largely upon the reproductive structures and behavior of the particular species. The following classification of reproductive types which occur among forage plants indicates the need for adapting the breeding method to the particular reproductive situation:

A. Cross-pollinated species

1. Freely wind pollinated - many forage grasses
2. Freely insect pollinated - many clovers, other legumes
3. Limited cross-pollination in related groups, increased fertility with decreased relationship. Alfalfa, ryegrass, Trifolium repens, T. pratense.
4. Limited sexuality - Poa, Paspalum (?)
5. Dioecious species, protandrons, or protogynous

B. Self-pollinated species

1. Slender wheat grass and some others
2. Many legumes - Vicia, Lespedeza (?)

C. Apomictic - Poa, Paspalum (?)

D. Vegetatively propagated - Cynodon, Kudzu, many subtropical grasses. Many species fall in two or more of these categories.

II. Advantages of the pure line method - homozygous selections

Uniformity and the assurance of stability
Preservation of particular, relatively infrequent characters
Intensive selection for specific types is possible
Ease of maintenance
Relatively complete analysis of breeding behavior is obtained
Optimum management system can be achieved

III. Disadvantages of the pure line method

Long period of time required
Loss of vigor
Rarity of the desired type
Lack of wide adaptability
Loss of genetic balance in the population

IV. Types of heterozygous selections

A. Naturally selected lines

1. Naturally occurring ecotypes or strains are the basic material from which adapted types which are homogeneous for certain basic desirable characters are selected. This is the pure line method applied to types instead of to individuals

2. Combinations of several non-related ecotypes or strains, regardless of origin, which have certain basic characters in common. These individuals must be more thoroughly known than those in the preceding type of selection

B. Experimentally selected lines

1. Lines based on a few unrelated plants of well known type and breeding behavior. This is the most elaborate form of "strain-building".

2. Composites from large numbers of individual plant lines $S_1$ or $S_2$, following very intensive selection in these inbred generations

V. Advantages of heterozygous lines

Vigor - maintenance of heterosis
Wider adaptability
Speed of the selection process
Genetic equilibrium within the population

VI. Disadvantages of heterozygous lines

Lack of stability, particularly under selection pressure, hence difficulties in management

Difficulty of preventing admixture with other types

Lack of predictability as to ultimate performance

Impossibility of attaining specific objectives as completely as with the pure line method

3. Breeding self-sterile and apomictically reproduced species

Discussion Led by O. S. Aamodt

Perhaps one of the best methods of discussing any type of sexual breakdown in plants is to compare or contrast it with the normal or usual mode of sexual reproduction. On the male side in plants the original germplasm in the form of pollen mother cells divides twice, each of which forms four haploid spores. The generative cell of each spore divides to form two male cells. This division sometimes occurs in the pollen grain before shedding but more often in the growing pollen tube after pollination. On the female side, the nucleus of the functional megaspore goes through a series of three divisions, the resulting nuclei lying free in the cytoplasm of the embryo sac. Usually, three nuclei remain at one end of the sac while the other two (polar nuclei) meet and fuse. The remaining three cells are usually found in the opposite end of the sac. Thus, in the typical embryo sac the picture is as follows: Three antipodal cells in the chalazal, an egg and two synergids in the micropylar end and between these two groups the polar nuceli (Diagram). When the pollen tube penetrates the tissue of the ovule one of the male cells unites with the egg cell resulting in fertilization while the second male cell unites with one of the polar cells which gives rise to the endosperm. Thus any plant arising as a result of this sort of reproduction would contain a combination of germ plasm from the male and female parents. In a great many plants, however, this type of reproduction has been replaced by other types in which sexual fusion is omitted and in which the progeny is identical with one or the other of the two parents (usually the maternal). These have, for convenience, been lumped under the term apomixis. Among the definitions of apomixis, the following one proposed by Winkler seems to have been generally accepted. According to Winkler, apomixis is the substitute for sexual reproduction of another, a sexual reproductive process that does not involve nuclear or cellular fusion (that is, fertilization). There is still some question as to the exact embryological picture in the apomictic grasses. However, in Poa and some other species the following observations have been made. In young ovules of Poa pratensis, Tinney has observed a

single macrospore mother cell which undergoes meiosis forming, usually, three haploid macrospores. Subsequently, however, the macrospores disintegrate. The embryo sac then develops without meiosis from a cell of the nucellus. The typical embryo sac consists of three antipodal cells, two polar nuclei, and the egg apparatus. According to Tinney the diploid egg develops into a proembryo by parthenogenesis (Diagram). Since apomixis was first discovered in the grasses there has been a tendency on the part of some to conclude that every uniform and true breeding species is apomictic. This obviously is not true but on the basis of more or less critical evidence, we can conclude that apomixis does occur in some degree in the following genera and species of the Gramineae. In the genus Poa, six species have been shown to be at least partially apomictic. In addition to Poa pratensis, these are alpina, palustris, glauca, and arctica. In the genus Eragrostis, one species, E. cilianensis, is shown to be apomictic. According to Burton, a number of species of Paspalum exhibit apomictic tendencies. In the genus Calamagrostis there is at least one apomictic species. In the genus Nardus one species, namely Nardus stricta, is apomictic. Some members of the genus Deschampsia have been reported as reproducing apomictically. This list concludes the extent of apomictic species in the grasses which have come to our attention. One may assume, however, that as more species are investigated, further occurrences of this phenomenon will be recorded.

In the past, a number of cleistogamous species have been mistakenly referred to as being apomictic. Although the two processes may have some similarities, they are certainly very different from the genetic standpoint. In the grasses, cleistogamous species have been reported in the following genera: Chloris, Stipa, Paspalum, Leersia, Erianthus, Poa, and Bromus.

The parthenogenetic origin of seed in grasses can be used to advantage by the plant breeder and seedsman. Many of the variations fixed by this mode of reproduction differ strikingly and favorably from types produced sexually. Numerous selections made by plant breeders with this mode of reproduction show uniformly good vigor. Good seed is produced readily and it may be that seed setting in apomictic forms will be less influenced by weather than in the forms dependent upon sexual reproduction for seed formation. In many respects this mode of reproduction is not greatly unlike that of clonal reproduction as far as uniformity of progeny are concerned. The problem of isolation or maintenance of the purity of an improved variety is greatly reduced when seeds are produced by this process. The occasional variant plant will not contribute seriously to the impurity of a grass variety. The formation of new types increases the possibilities of selection in a species already rich with variants and potentialities for better adaptation to grazing under different environmental conditions.

Tuesday, July 22

9:00 A.M. Room 207 Building: Daniels Hall

IV. Methods for evaluating new strains of grasses and legumes

Chairman Glenn W. Burton

1. Observational rows or plots - (a) Discussion Led by Paul Tabor

The research program of experiment stations, as I see it, is based primarily on experiments. They can bring everything to bear on the various methods (five discussed) used by the extension and action groups. You get the experimental approach applied in that way. We hope in developing this program of supplemental plantings that we can get the research stations to take the one that looks real promising and put it under a series of control tests and allow our people to make observations and to get the results which they obtain from these experiments. Thus we hope to get improved opportunities for observations. Now these divisions in responsibilities and activities may not be entirely clear-cut. I don't think they are. In either of the five there should be a certain amount of intergrating. For instance, in trying to develop this subject, it occurs to me that a great deal of the research program of experiment stations is based on observation. A good deal of the research, actual experimental work, that is being done now simply may be a means of developing a measure that can transfer that type of work into observation. That has happened in chemistry. It has happened in physics. It has happened in a great many other things. I will say that the determination of soil pH. at the present time is an observation. At one time it was a definite experiment, but a method has been perfected that is at the present time simply an observation. Now we find a good many other illustrations that would answer the same purpose. For instance, even qualitative analysis by the spectrographic method might be called an observation at the present time. Here we have a method that is developed to the point where there is no longer an experiment. We need to get a great many of these standardized methods that are real tools to transfer a certain line of work that we are doing now from the experimental over to the observational side. Carrying that philosophy on, it seems to me that most of the things that are being decided today are being decided from the observational viewpoint. And a great many of the observations are being made as a result of experimental work. It seems to me we need new methods particularly in plant research. I have had more or less a pet notion that sometime, I hope in the near future, that we can have as an analysis of forage plants complete enough and accurate enough for us to judge their value as a feed from the chemical analysis. I believe it will be possible now for the chemists to carry on their experiment to the extent they can give us a method of measuring forage values that we can eliminate a great deal of the experiments that are being

run at the present time on determining food value by chemical observation in the laboratory. Now, Mr. Wilkins tells us that maybe sometimes there is going to have to be some thirty separate determinations made before you will have an analysis that is complete enough and adequate enough. Well, I have the same dream or have had for quite a while in determining the adaptation of plants. I believe there is a possible measure, for instance, to determine the climatic adaptation of plants. At the present time, we largely overlook that. We repeat our experimental test, our rod rows for observation, at a number of points and just assume that the climate at these points is enough like the climate within a hundred miles or approximately that distance. I believe we will go far beyond that. I believe the time will come, I hope not far in the future, when we can so classify a forage crop that we can forecast the climatic adaptation and the soil adaptation. If we can do that, why then it seems to me in forage crop research we will be approaching what the chemist and physicist have been able to do in their fields. But, of course, we are far behind that at the present time. At the present time our methods are comparable to methods that might be described by main strength and awkwardness and more or less hit or miss. It is probably as much experience in our trial and error experience as experiments that we are mainly conducting.

Now, I have tried quite a few schemes of expressing the climatic adaptation of plants and I haven't, of course, hit on one that is good enough to be generally recommended or adopted. The general efforts that have been made have been to recognize a monthly mean minimum temperature for various crops or various plants. For instance, we get very little growth if the monthly mean temperature is below forty degrees. Now growth starts about that time and the very cool climatic plants are able to grow at forty degrees unless they are of winter habits, but there are other influences that come in that we can group. Down here in the South during the entire winter our average temperature is above the forty degrees and we get growth from this type of plant. And as you get further south, why of course you get more growth, because the average monthly temperatures are higher there. I think the general recognition of the length of growing season as a frost-free season is a rather serious error here, because we get cool climate plants in the winter. You don't get it if the average temperature is below forty. Plants with a starting point of growth of forty degrees average temperature don't continue to grow indefinitely. Those same plants don't grow in the summer when the average monthly temperature gets up to seventy-eight degrees or eighty-one degrees. They drop out. They go only about thirty degrees up the scale, and probably the first twenty degrees is the optimum temperature. When they get above that, the temperature is too hot. At least, it is associated with poor development. There may be a short spurt of growth, but the plants are not able to endure continued existence. Now there must be something quantitative about this. In fact, I think there is. I believe I can take

an average monthly temperature for any station in the country, the number of nodes a variety of corn develops and can forecast your tasseling and silking dates at different times of planting throughout the season by a formula that has been developed. Now, of course, that doesn't work on very poor soils where you get decided limiting factors, but in a general way now it seems to work except for the more northern varieties that are not able to slow up their development down here when real hot weather comes on. The only places I have real difficulty with this system is down in the High Indian Mountains in the extreme northern limit of corn production. I believe also I can forecast pretty well the blossoming of the cotton plant on the main extremes under good soil conditions. Now, of course, that is limited. I have a formula worked out based on average monthly temperature, presuming the other conditions are ideal. That seems to fit the case pretty well. Now, of course, that is just a bare beginning of it. In fact it is not getting down really to the essentials.

Aamodt: Are there any exceptions to that spread between a threshold value and a range of twenty or thirty degrees?

Tabor: Yes, there are some exceptions. There are some groups of plants that don't have that limitation. Well, take the Kentucky bluegrass, for instance. Now, my own conception of Kentucky bluegrass in the far South is that it has the ability somehow to slow up its activity when the weather becomes too hot. That is a good deal like some of our negroes and mules. They may step along all right when the weather is cool and comfortable. They simply slow down when the weather gets too hot. I believe most of our well adapted varieties of corn are here in the far South. It may be only strains of Kentucky bluegrass, but certainly the strains that are selected naturally here in the South have that same ability because somehow Kentucky bluegrass can hold on here much better than this theory assumed; but that is somewhat of a different story because I think we will have to recognize two things here. One is the temperatures that are favorable for developing and the other the temperatures the plant can endure. In other words, one idea is development and the other idea is endurance. You will find approximately thirty degrees range will cover practically all of our forage plants. It may be somewhat higher in some of them. Some of the species like some soybeans seem to have a very wide range through the adaptation of various varieties. Now, of course, this solution is not a short kind of solution. We can't use it, for instance, to differentiate a great many of Mr. Burton's selections of Bermuda grass, for example, because we don't have the methods developed, but somebody who doesn't recognize that this is an impossibility is going to give us through controlled experimental research a method of determining whatever causes this response to the temperature; and then perhaps we can have a measure that we can apply to his five thousand or more strains as a new tool for observation. We won't be dependent just simply on what we can see directly in the plant or about the plant.

Well, one other idea or else I have stretched this out too long. Our observation of forage plants should be carried on longer than a single year. Now, when you have tremendous numbers that might not be possible. The response that we are seeking may be a three or five or ten year response rather than a one year response. So our plantings that some of you saw at Chapel Hill, we expect to keep some time. As long as they continue to grow well, you want to maintain them there, and we hope that these other plants will make cooperation with the research stations throughout the State and we can have tests that will be continued over a series of years. Now, of course, you are invited to make all the observations you can on any of the material we have and we will be glad to share anything we have with you. We hope it may be arranged to supply some seed for basic experimental tests. This has been done in a limited way on our own responsibility, but we hope to develop a memorandum of understanding by which we can do this without any questions.

Aamodt: I might just follow one idea that Dr. Tabor mentioned. I don't think it should be passed over too quickly. Last spring (early April) I found strips of green bluegrass across the central part of the country - Washington, D. C. to Denver, Colorado. Everything was brown and dry to the north and to the south. That is because bluegrass was starting to grow at its threshold value, on its southern fringe, but not to the north. The southern grasses with a higher threshold value were still dormant and brown. Probably we should be breeding for frost resistance and lower the threshold value in the South. It would be a wonderful thing if we could get a plant growing in the South in the winter and at the same time tolerate maybe 30 or 40 degrees higher temperature to meet the summer conditions.

In some cases the length of day is important. It may be the most important factor in limiting the adaptation of grasses in the Western Plains.

Chairman: Thank you, gentlemen. It is going to be a great day when we can take a formula and pick out the best of five thousand plants. I am looking forward to this with great anticipation. I am afraid from the present stage of our knowledge it is going to be some time. I may never have the pleasure in selecting plants in that manner. As we are discussing this topic, we want to be sure to keep on the subject. We still have some ten minutes for which we can spend our time in the first topic. We will spend our time in four equal quarters. We have got another man, Dr. Hoover, who knows a lot about this sort of work and who has had a lot of experience with it.

(b) Discussion Led by M. M. Hoover

Mr. Chairman, in discussing this matter with Mr. Tabor previous to the meeting, it occurred to us that it might be of interest to the group if I would review the program from the national standpoint to tell you of the progress that has been made in some region other than the Southeast and in so doing chart the course that has been followed in some of these other regions as a possible course of development for the work that Mr. Tabor has outlined here. Now in doing this, I don't propose to set up a model. I thought you might be interested in some of these problems. First of all, I would like to present a little of the Soil Conservation Service background and some of our experiences during the last five or six years. To understand that, I think we should first of all appreciate the fact that the Soil Conservation Service is an action service and the operation of the program demanded an action program to go along with it. In many parts of the country the need was very urgent for plant materials to establish vegetation, if for no other reason. I am thinking particularly of the so-called Dust Bowl area. The Southern Plains area would typify that. It was very urgent that plants be established on these areas. Forage land that at one time had been in crops must of necessity be returned to sod as quickly as possible. That is one of the problems and so I could go to the Northern Plains, to the Pacific Northwest, to the Southwest; and we would find in each of those areas a need for materials that were not available from commercial sources. So the beginning of this so-called observational program was a search for those materials. We have been very greatly helped by other Federal bureaus and by the respective experiment stations and workers, among them yourself. Those who knew the plant materials were able to give us assistance. Being an action agency, however, in many of these areas we did go out into native stands of plants, grasses, collected seeds, and used that seed for revegetation purposes. From the standpoint of the value from a research viewpoint, that might be questioned. Nevertheless, we can point to many acres of stabilized lands where that action did produce results. We were keenly aware from the start that the materials that we were using were not the best and there is where we have set out cooperatively with other bureaus and with the other states of which Mr. Tabor has spoken and starting out first with the obtaining of these initial materials many of them have come from introductions from foreign sources. Many of these have been obtained from native plants within the areas or plants transferred from other regions. We have set about the analysis of the observational material in the initial rows and on into supplemental plantings which are an attempt to place the materials out under field conditions, that these must meet in order to survive, and hence on into the next point would be the matter of commercial production. And there again we work very closely with these other agencies. So much for the statement of the problems. These regions have various areas or problems that are rather specific and relate to the soil climatic conditions that exist within those respective areas. The accomplishments today, I think,

will be brought out again in the discussions of this morning when we discussed the uniform nursery test and again this afternoon when we think of the new uses of these plants. However, it will suffice at this time to say that in this observational approach and in this method has been devised to obtain quickly the materials and finding and using plants that meet specific conditions. In many regions the observational program has progressed to the point where confirmatory plantings may be made in the supplemental areas of experiment stations or on farms of cooperators or widely scattered parts of the area in which the Service is working. We have been able to increase seed, and those materials very shortly will be available for still wider distributions. We feel that that type of work needs some orderly arrangement to guide it in order that these materials will not be turned loose promiscuously and the value will be lost in them. We would like to emphasize again the outlook from the standpoint of materials that have been brought in in this method as very promising. I can cite many of the new species coming forth from introductions from abroad and from selections that have been obtained from native stands that are now in the increase stages and some of these are available on the market. The thing I would like to emphasize first is the type of work in which you men are primarily interested in, being the thing our service is also interested in doing. That is, encouraging the selection and the improvement of your strains and bring those along to the point where they can be increased and seeds made available generally to the public. The Nursery Division of the Soil Conservation Service that I represent are set up for that purpose. We have a rather large production program both from the standpoint of woody plants and herbaceous materials. We should like very much to encourage you people in your work to make use of facilities which we have for the increase of this seed for our general use. We feel it is only in that way that the farmer cooperator is going to profit most.

Chairman: Thank you, Dr. Hoover. I am sure all of us will be very much interested in getting this picture of what soil conservationists are doing in their nursery. We can afford to take advantage of what they have in their nurseries. I see Roy Blaser back there. Every time he and I get together we have a little session about methods and techniques. Roy has got the idea with the eye when it comes to measuring things. Just give us about three minutes on your philosophy on that subject, Roy.

Blaser: I have been using this observation system a great deal. The first time I heard it discussed was in Chicago about 1937. I am glad to see that there is interest in hearing the idea behind observational tests. You take folks that are grading hay, as an alfalfa hay for example, and after an eye is trained to estimate something they hit it very close. I used to judge hay on a judging team, and it is remarkable how the eye can be trained. From that we felt that why not train the eye to observe changes in species with different fertilizer

treatments. The idea of any observation system is to keep the mind open. Now the mind can only comprehend so many things at a time. Now then, the best scheme is to have one man writing down these data and another man taking those observations; but I assure you it is laborious if the composition is made up of five grasses and a legume together. Now then, when Mr. Warner and I first mentioned this system, he wanted an observation system, and I told him what I had been using. He shook his head. But we got out there on our experiment and he took to it very quickly. We feel by using this observation that we are getting a lot of accurate information, and we are also turning back more information to the farmer for the amount of money spent. I really feel that way about it. Thank you.

Brandt: I don't think he should use the word accurate. It is perfectly alright to take observations that are within bushels until you get the nearest bushel, or then if you go to work in grasses, of course they are both accurate. I hope they will change to precise instead of accurate.

Chairman: Correlation observation is rather difficult. I think that is an important thing. It does have a place in the evaluation of grasses. It certainly is a very rapid method. We are dealing with hundreds and thousands of strains. We are working with a number of different plants. We have got to use large numbers. And we have got to have some sort of technique to handle those large numbers and do it economically.

2. Clipped plots - Cages, clipping technic, etc.

Discussion Led by M. A. Hein

I think we start off on clipping. We are all more or less familiar with methods on clipping technique in harvesting plots. It is a much more difficult problem I would think to get accurate measure within strains and to be sure that you have the most desirable strain from the breeding program. I am pretty well satisfied that at present we get a rough measure of yield. But when we come to measuring small variation within different strains, well, that's another thing. I don't think any of us are going to really consider the grass alone. Clipping may not be necessary in some of the preliminary stages, and I don't think any of us have funds sufficient to make yield tests at all times. I think the question of plant cover and disease-resistance is a pretty good indicator of the value of the new strains. I think you can work out why you could get some determination of the hay value and possibly some of the seed production of this strain in these preliminary small plot tests.

Chairman: Thank you, Mr. Hein. Peter Bennett has something back there. What are you doing over there in Mississippi, Mr. Bennett?

Bennett: We are working on Johnson grass for the simple reason that Johnson grass is about as good a pasture grass as we have. So we are trying to get some leafiness in our Johnson grass. Last night some of these men were asking what type of grass they are working for. We are after the Johnson grass. But we will have to work out a clipping technique on our various selections and strains of Johnson grass, but, of course, clipping is one of the best ways to eliminate Johnson grass. Any farmer up on his toes puts it in cotton and next year he really has got Johnson grass. So our clipping measure is going to have to be whittled down in comparison to another grass for the simple reason it can't take it regardless of Johnson grass. But I don't have any information to contribute, Mr. Chairman, except that I would like to say that Johnson grass is not the big downfall of the country as a lot of folks seem to think. Now, we are making a varied number of clippings and we don't have anything conclusive yet, except that they differ very widely in their ability to take this punishment.

Chairman: I wonder how many fellows here that are using the lawn mower to make clippings. Is there anyone using the bar mower? They ought to be able to give some comments as to whether the two are useful.

Brown: I find that cattle do not graze the grass down to the ground close enough. So we are going to have to use a bar mower.

Chairman: Would anyone else like to comment on that?

Myers: If we have plots we don't want to cut too close, we use the bar mower for that purpose. We have obtained the lawn mower that seems to do just about as well. It has an adjustable height up from about half an inch. At least, I believe three or four inches is the maximum height we can obtain on a bar. That means we cut just about as high as we do with a bar or, in fact, a little bit higher.

Chairman: We have only used the bar for a very short time, but I believe its use is going to be very useful for preliminary introductions and some of the early stages of your study of the grasses. I don't know about your experience with the lawn mower. On Dallis grass it is almost impossible to keep those heads from getting out with a lawn mower.

Lovvorn: If these sickle bar mowers would work they would be fine. As you know, we have to either go ahead of our reel mowers, and we thought this hand sickle bar machine would be just the trick. I am not very proud of it. We can't get enough speed to operate, unless you walk very rapidly there is so much friction the wheels will drag before your sickle will move.

Chairman: It seems to me that all of these various clippings would be sufficient. Those of us who are doing breeding work, of course, want something that will give us correlation and will not require any more work than is absolutely necessary. You can cut those at weekly intervals and you have to take a good many cuttings that would have to be analyzed. You would have to take a lot of time and maybe cut it once a month or once a week. That would certainly be a time-saving element.

Ritchey: I am very much impressed with a remark Dr. Brown made a minute ago. We are going to have to develop our methods with the grasses we are growing. I am wondering if it wouldn't be a rather profitable thing for some place in the country to originate a project to make a study of this. We have no information on this.

Chairman: Does anyone have anything else to throw out on that? He got pretty close correlation between his gains, I believe, on his local pastures and his clipping yield which is rather gratifying. I don't know whether he can select new strains or evaluate any new strains. It has been my observation that observations are good if we don't have to make too many of them. It is rather difficult for us to carry in our mind a standard which will permit a comparison of plots which will be close to the ones we are trying to evaluate. Yields are very convenient in measuring productivity. The productivity is a very important thing. We may have a thing here that looks very nice, but if that thing will not produce as well as some of the other things, our livestock men didn't think so much of it out there in the pastures. Are there any other comments on this?

So much for clipping plots. We haven't settled anything very definitely. For the last two or more years we have been talking about grass nurseries. Last year I think five were established throughout the United States. I believe Mr. Hein is going to tell us a little about those.

3. Uniform grass nurseries - Discussion Led by M. A. Hein

I believe it might be of interest to the group to give just a little history and the accomplishments in connection with the uniform grass nursery work. Two years ago, when I was out on a field trip, the problem was brought up as to what can be done to evaluate strains, and what kind of program can be developed to learn as early as possible the adaptation of new grass strains. The selection and breeding work with grasses, while still in its infancy, has progressed far enough to demonstrate the need for reliable comparative tests of the many new strains which have been or may be developed in various sections of the country. It is essential that regional adaptations be determined before these grasses are officially released for increase and general distribu-

tion. It is desirable that we have a coordinated program for testing the regional adaptations of new and improved strains with all interested agencies participating. Several occurrences in recent years suggest that there be initiated some coordinated interstate system for wide testing of the performance values so as to keep at a minimum the development of chaotic situations in the introduction, increase, and use of new strains of forage crops. It is difficult to evaluate different strains of grass unless they are grown under uniform conditions and receive comparable treatments. In making such comparisons it is proposed to test the more promising strains under as many environmental conditions (including variation in management and treatment) as possible. The Division of Forage Crops and Diseases is prepared to assist with this work by making, as far as possible, its personnel and facilities available for (1) a survey of improved varieties, (2) the exchange and distribution of materials, and (3) summarizing data and preparing joint reports. Nurseries were established in 35 States this year.

Chairman: Are there any other comments on uniform grass nurseries? Well, if not, we go over to Number 4. If we had all the land that we needed and all the money we needed and all the livestock we needed, so we could take on some four or five selections of different grasses that were growing and plant two pastures for each one, then we could make a good practical test. Well, what sort of methods can we use with livestock which will help facilitate our evaluation in a practical and economical way so that we can get information that will be worth while?

4. With livestock - Discussion Led by T. E. Woodward

If I were going to determine the value of plants for milk production, the first thing I think I would want to know is whether the dairy cow would eat that plant or not. If the cow won't eat that plant, it is not good no matter what its chemical content is. I would want to know how much it would produce by itself or in combination with other plants. Then, I would want to know the chemical composition. If we know how much a plant will produce, if we know its chemical composition and if we know whether cows will eat it or not, we can make a pretty good guess as to how valuable it is for milk production. Then I want to knew if it will taint the milk. And lastly, we want to know what kind of a hay crop it is. Is it a pasture crop or is it like some of the others that are pretty good for both?

Let's call the new plant "x". And we will say that it is to be compared with some standard plant whose place it might take in farm operations. This is just a suggested plan for an experiment to determine these things that I have just been talking about. There will be six plots here. In one we might have the new strain or new

plant by itself. In one we might have a standard plant that we are going to care about. In another one we might have another standard plant, then in one a combination of the new and standard plants. Then by running the cattle on here we could tell how this plot was grazed in comparison with all the others. We could note how readily the material was eaten. And by the way, I think we just as well determine the yields with the same setup. To do that, I will have these plots small. I don't see any use in having great big plots, about sixteen by one hundred feet, each one of them the same. I would replicate that about twice, probably setting these up at random. It would be pastured continuously. We would see whether this would stand continuous grazing or whether it wouldn't. Then we could have some more plots over here that will be replicated twice in the same way where the grazing is in rotation. There would be some plants that might not stand continuous grazing, but rotation grazing.

Now to get the yield, I would suggest using cages in these plots. We use a four by four cage. I put two in each plot. Ever so often I change those cages. We have used that system for quite a long time, and I haven't been satisfied with it because of the problem of relocating these cages. I followed around after some others that have set those cages and my judgment and their judgment is sometimes quite different. Or is it to be set entirely by random. I would never go to the same plot the second time, not in the duration of the experiment.

Whether I pluck or whether I clip, I don't think it makes so very much difference. We practice plucking right along. I think I might be the first one that ever plucked a pluck. Plucking is all right, but we still need the matter of human judgment as to how close to pluck. We think a plot is properly plucked when you get through and go off and leave it and you go back and can't find where you plucked, then it is a perfect job. Otherwise it isn't a perfect job. The matter of human judgment comes in. In that case, I would just suggest that it might be a little better to clip these four by four plots and then clip another plot that is selected entirely at random. Select cages entirely at random and clip it by different methods. See how much was raised by that time. If a person did that, I think the plot should be twice as big as it is. That would mean four clipped areas in a plot instead of two plucked ones. Well, when we get the yield of that crop by itself and in combination and we get the chemical analysis, and see whether the cow eats it or not. We can pretty nearly tell how valuable it is for milk production without going any further. But we may run into a plant like sweet clover, for instance. Now if we put sweet clover in here, it won't be grazed at all until these were all gone, and perhaps we won't get the true value of the sweet clover. In that case, we would have to have another plot where the sweet clover is grown by itself, and probably a much larger plot that would take three or four cows. Then we want to know how much that plant was worth as a hay crop, and that would require

still another plot. And I think I would grow that in combination too, but in combination with those crops that are more generally used for hay. Now, I realize that is going to open some argument, especially with reference to this matter of cages, the method of setting them, etc. I hope you won't be to hard on me.

Chairman: It seems to me you have got a good idea of location of these cages. It might be worth while. Of course, if you get into large areas such as we used for beef cattle, then I suppose it would be impossible to do it that way, but we do run into differences of land. We have a change in the flora of the pasture and that bothers us too. We might have one grass when we start in, and five or six years hence we have got an entirely different combination.

Woodward: I didn't intend it that way. I just presented the most important ones that occurred to me.

Chairman: Woodward presented the most important ones that occurred to him. As we think along that line, it is rather difficult even to list the most important ones. It is quite apparent already a lot of them you see how many plots we are going to need. We are going to have one grass with a number of different grasses. Now, here is the time for you to give us some real assistance on this thing.

In grazing, the cattle don't graze as close as clipping. Is that your general experience?

Woodward: Yes, if you are clipping with a lawn mower. If you are clipping with an ordinary moving machine. But anyhow a person would want it clipped as low or even lower than what they graze in order to be sure and get by difference how much they had taken from the pasture. I think as a rule you will find that the lawn mowers will cut closer than the cows ordinarily.

Chairman: Any other ideas or comments?

Member: We have been using sheep. We don't have a direct comparison with sheep and dairy cattle. We have been using sheep in a series of plots. One series has been clipped and the other has been grazed with sheep. Those pasture mixtures haven't turned with cattle grazing. For example, sheep have shown an aversion to rye grass which cattle have never shown out there. We still have far more of it in there under sheep grazing than under the cattle grazing. Sheep are more selective than cattle in their grazing.

Tuesday Afternoon Session

2:00 P.M. Room 207 Building: Daniels Hall

V. Methods of evaluating new grasses and legumes for miscellaneous uses

Chairman John Monteith, Jr.

The methods of measuring grasses for these special purposes have not been developed very well. I guess to do so is to simply have a general discussion of our objectives and purposes, and the methods of evaluation. The one thing, of course, that is apparent or should be apparent in this group of subjects, is that we have something here that is different from the pasture workers in that here we are not interested in yields. That is sometimes overlooked, unfortunately, as in the case at a western University I visited not so long ago. Some tests were in progress to find the best fertilizers for the lawn, and some of the people in charge of the grounds, convinced that they had the answer that such and such a treatment was unquestionably the best fertilizer method, and I asked on what they based their judgment: "It had far outyielded the other plots."

Mr. Brant has to leave early. It's been suggested that we change the program and now have item Number 4, "Soil and water conservation".

1. Soil and water conservation

(a) Discussion Led by B. H. Hendrickson - Brief general remarks on soil conservation.

(b) Discussion Led by W. O. Ree

In conservation work we build terrace systems to collect the surplus run-off water and convey all of it in some stable grade such as a stream area. If we do not protect this central collecting channel outlet, it will break and you have done more damage to your land than probably you would without terracing. Now, we could protect that channel by lining it with concrete; that would be quite expensive. No farmer would want to, so to meet this problem, we turn to vegetation. We can grow grass in that channel and it would protect the channel from scouring. Well, the engineer, of course, wanted to know how fast the water would run down the hill, how much the grass would protect the channel and when to resort to laboratory experimentation. At Spartanburg we built the outdoor hydraulic laboratory. We have facilities where we can build various types of channels and waterways, plant them to grasses, cultivate them, treat them like the farmer would and then subject them to flows of water. We have a raised lake with about five-acre feet of water in it. We can draw water from this reservoir and measure the scouring in the channel, compare it with the velocities existing, and the mean protective ability of each grass. We learn how fast we can allow that grass to go down, and how fast we can allow

the water to go down the slope covered with that a particular grass. We can control velocity by altering the cross section of the channel. Anothre reason for using vegetation is that farmers can get economic returns from the waterways. We often call these waterways strips, or pasture strips. They are broad, one to two hundred feet wide; if necessary, they will act as a channel to carry storm run-off; at the same time they will yield the hay crop and they can be used as pastures.

Now we have limited our work to just a few of the grasses and legumes used in soil conservation work. Bermuda grass we find to be excellent grass, at least from a hydraulic standpoint, it took terrible punishment both in the summer and in the early spring. We'd like to plant Bermuda grass in all of the waterways. Farmers probably wouldn't like it, so we tried other grasses. We have tried Sudan, Dallis and Centipede. We have tried Lespedeza sericea, common lespedeza, and Korean. Now each of these plants has been planted in a waterway. Some of our results just briefly summarized are: Bermuda grass will take a velocity of 8 feet a second; that is a fairly high velocity. Sudan grass would stand about five feet per second. It is not nearly as resistant as Bermuda, or Centipede grass, which will take at least nine feet per second in summer and about eight in winter. Lespedeza sericea—I have data on one year's stand--took three feet per second, common lespedeza, which offers no protection in the spring, will stand about five feet per second. Kudzu will stand four feet per second in the summer and about two and a half in February. That is the type of information we try and get for the conservation engineers. We expect to continue evaluating the hydraulic power of these other grasses. Now just to sum up what we know about grass, we feel that a good cover from the hydraulic standpoint would first of all be a perennial; it may not give you much protection in the spring; it should bend over under the force of flowing water; it should provide a dense cover, and it should have the strength and stamina to bend downward and to rise again; otherwise, the grass will rot in the channel. This is a rather hurried talk. If I have made it clear, I'd be glad to answer any questions.

Chairman: Any questions on this?

Question: I'd like to know how large an area it takes to make such a test and could a series of grasses be put into a channel and get a simultaneous test? Just what is the technique?

Ree: Well, our channels at the laboratory are all side by side, and we feed water into the channel from our reservoir—any number of channels on one plot or you could arrange your channels in tents as they do out in Missouri. They have about four channels in a tent. Your channels are fifty feet long, possibly thirty feet wide, depending on the cross-section. They really don't take up very much room. We are limited for space, they should be at least a hundred feet.

Chairman: Any more questions?

Question: How old was that sericea?

Ree: It is what is known as a one-year stand; it was planted in the spring and tested in October. It had not been cut. We have since made many tests on sericea—just before cutting and just after cutting, testing the characteristics, which are changed.

Question: Could you use bluegrass?

Ree: We haven't been able to test bluegrass. We haven't been able to grow it successfully. It is being tested or is going to be tested in Missouri.

Question: Was the comparison on your sericea fields compared to your lespedeza? I wonder what age of growth you had there on your sericea and what your previous treatments had been on them.

Ree: It was planted last year in the spring. We got a very poor stand. We replanted it again this spring. We have a good stand down all the field. Plants are very small. I don't think that it is quite fair to the sericea.

Chairman: We will consider the turf for lawns, parks and cemeteries more or less as one group. They are problems that are very similar. There has been less work, probably, on lawn grasses than any of our agricultural plants and probably there's been more recommendations for lawn purposes than upon any other plant. A man in the seed company ought to have some pretty good ideas of what the public likes in a lawn, so I asked Mr. Mackay, of the Wood Seed Co., to tell us what his "headaches" have been and what he thinks is necessary to help better our lawns.

2. Lawns, parks and cemeteries - Discussion Led by F. J. D. Mackay

I'll go ahead and start something and we will work it out. Lawns, as you know, are planted for many different purposes. Some just to fill in bare spaces by people who are really critical and who want something fine, and then again we have lawns planted on slopes on rolling land and on flat plains--all sorts of conditions. To make a long story short, the preparation of the seed bed is at least 80 percent of the factor in getting a first class lawn. One of the principal things is the drainage. A man comes in and wants to buy 50 pounds of lawn seed; he gets no lawn and says the seed is no good. That is the first thing we hear. On the other hand, the man who will make the necessary seed bed, and with a very little care can keep a lawn in good condition in almost any climate. When I say that, of course, it is understood that an adapted grass was

selected, since for various conditions, of course, we have to use different grasses. We should depend on the grasses which thrive locally. Take, for instance, Bermuda grass--well, we will find a great many different strains of Bermuda. Often there isn't any seed available of the special strains. There is simply a selection, and such a selection can be grown vegetatively. For the southern area, the Coastal Plain area, you should depend largely on winter grass except in shady locations. Unless the lawn maker is willing to pay for the finer seeds, then he can't expect to get the best results, that should be borne in mind. Now the highest grade seed should be used in the making of a lawn.

Chairman: Any questions on this? Mr. Mackay has emphasized the need for a good seed bed, which of course we are glad to endorse; but, as most of you know, and he of course recognizes, that most of the lawn work is not the establishment of new lawns. The average home owner has a lawn wished on him when he buys the property and basement and lot--then you are supposed to have a lawn thereafter. And while it would be the desirable thing, of course, to have this proper seed bed, they don't have it and the deterioration sets in, and in time they need some renovation and fertilizers.

Ritchey: The planning of these lawns with the vegetation method. We people in Florida are pleased with southern grasses that have to be propagated vegetatively. Now the most common lawn grass at the present time is Centipede. It has gained favor all over the State. I suppose it never had before. There is a great deal of St. Augustine grass that is being used. Both of them just vegetatively propagated. Carpet grass is used some and that is planted from the field with the Centipede and St. Augustine. We have the two companies in the State that are selling St. Augustine, particularly what we call the blue strain which is claimed by some to be resistant to the chinch bug. I have found no one yet that claims to have chinch bug resistance in that particular strain.

Albrecht: I wonder if anybody here is interested in the new Zoysia grass (Manila grass)? It is an excellent grass from many standpoints. It requires very little mowing. It is the first grass that comes out in the spring and the last to leave in the fall. It does well under shade too. Mr. Brown, of the Alabama Extension Service, put a small section in the back of his yard and then gradually transferred that into a Manila grass sod. He took a short section of two inch pipe, sharpened at the edges here, and attached them to a hollow rod. He cut out a plug of his Bermuda grass, then went to his Zoysia grass and cut a similar plug for replacement in the Bermuda sod. In about two years it spread over the entire surface. In competition with any other grass that is rather slow but, of course, it saves working your soil. A lot of work has shown that the sprig method is preferable to plugs. Your spread is rapid when you put a sprig into the soil. I am sure that method would work because I have

seen that in use for a great many years in Auburn, Alabama.

Chairman: Just a regular post hole digger is used also.

3. Golf courses

Chairman: Now this subject of golf course turf is one that the U. S. Golf Association has been most interested in because our funds come from the golf people. In golf courses we have the most intensive practice of turf culture. In general there are somewhere around two acres, one or two acres around the golf course that are kept up in the very best possible condition. Fairways are kept in much better shape than most lawns, but in the main, methods there are very much less intensive. The question of measuring grass for these purposes are, like lawns, rather difficult because there is no measuring scale that is quite satisfactory. The golfer is our measuring stick and he is a very fickle kind of appraiser. Condition of grasses is very closely correlated with the score on the scorecard so that fact is one that we have difficulty in sorting out and coordinating, but we do have a method of developing these grasses that have produced turf that has made the turf on golf courses in this country regarded as the best turf on golf courses in the world. The best turf in the golf courses has been produced by the application of scientific principles and had greatly exceeded, even with very adverse climatic conditions, turfs in better environments. We are going to ask Gordon Jones to outline the methods of checking and testing turf grasses for the golf courses. It is a little different than that used in much of your other grass work, so I think it might be interesting to have just a rough sketch of the way it is done.

Discussion Led by Gordon Jones

Through all the adverse conditions existing on golf courses and to which the playing green is subjected, strains emerge which seem to be very superior in color, drought and disease resistance. When these are observed on golf courses they are catalogued under a simple number, planted in a nursery and also in sod plots. Bluegrasses are handled in the same way. Oftentimes, in a lawn grass, tennis court, fairways, there will be areas of as large as ten feet in diameter of one single strain of bluegrass. Those of you who are carrying on these various experiments with bluegrasses and experiments in the observational methods in evaluating them find that usually you have to resort to breeding, clipping, or some other method to determine what their actual value is for the purpose for which they are intended. We cannot determine from appearance whether they are going to be good turf grasses or not, keeping them as turf for at least three years and usually five years before we can feel that we do have a superior turf. My practice has been to put them in small plots, and turf nur-

series and as they show relative values, reselect them and put the better ones in a large block which is replicated four times. We also send these out to various golf courses throughout the country. We had about fifty experimental greens, usually twelve strains to a green. In that way our selections show their adaptation to the section in which they are to be used. We find extreme variation in adaptation in the strains. As yet we have not set up any seeded areas from the bluegrass selected strains, but we have found several which apparently are breeding true, whether apomictic or not. At least their progeny have proved superior, and have been released to seed companies for increase. As yet, there are none available on the market commercially, but we have several which seem to be very promising, and they are being increased.

Chairman: Members of our staff rate these grasses up to a certain stage and then we pass them on to the experimental greens and the golfers to rate. That is our measure. We feel that regardless of what we think about them, their success is going to be entirely on the verdict passed by the average golfer because he is the fellow who is going to supply the money. We have been very much disappointed in our ability to correlate growth in the nursery with results in the plots. It looks like we are going to have an expensive method of testing. Now are there any other questions on this golf, or other turf experience, that you fellows want to talk about?

Question: This Centipede—is it alright?

Jones: Well, it doesn't die out. None of these will die off. Was that down in Florida? Were both the Bermuda and Centipede discolored?

Speaker: The Centipede turns brown with the first frost and goes into dormancy. As a rule, warm weather brings it out. The first frost comes about the middle of November. By the first of December it is all brown and we don't depend on it for green color. Bermuda has a tendency to stay green if it is well fertilized. The first good heavy frost will turn it brown. It will come back with the next growth and then in the spring of the year the Centipede will turn green, probably about the first to middle of March, and Bermuda a little bit earlier. When they are off color from a cold period in that territory, the plan is to immediately fertilize and in a short time as soon as the temperature goes up, fertilizer will pep up the growth. In Florida they count on rye grass for color, but the big trouble throughout Texas and up through this territory is always in getting that rye grass out of the way in time to give the Bermuda grass time to thicken up.

4. Road embankments

Chairman: Any other comments before we go on to road shoulders? One of the road men explained that he had read all the bulletins he could find on growing of grass. He found here and there recommendations that if he did so and so he could expect to increase the yield from a ton to two tons an acre. He wanted the methods that would decrease the yield half a ton to two tons an acre. We are fortunate to have with us Mr. Neale, who is engineer of the Virginia Highways and also Chairman of the National Research Council Committee on Roadside Development.

Discussion Led by H. J. Neale

I came prepared to listen. I had a lot of questions I wanted to put in some way or another to see if we could get some information as to what has happened in the last ten years. From a local standpoint, or from a national standpoint, we don't feel that we are getting all that we should out of the grass seed and of the fertilizer we are using. We have the same problems that the agriculture of the various states have. A definite problem for the state experimentation is soil improvement. We have the poorest kinds of soil. When a contractor goes through his job, unless some provision is made for salvaging of the top soil, he gets the poorest kind of soil on top and then we must go out to the farmers and ask to buy some top soil. We need all the top soil we have. I have noticed in some meadows and some pastures where we change the water table completely by making cuts through there to get a road bed and the farmer refuses to let us go back to plant even his slope; he refuses to let us go in there and sod that slope, he hasn't been told that we are providing ground water for his pasture. The problem is to find something that will grow on those slopes that will control erosion--the type of grass or turf that will not produce a big yield, that will not require more than one cutting a year, except on the shoulders. That cost of 25 to 50 cents a mile can't be done very many times in the season without increasing maintenance costs. Now all of this has been brought about in the last ten years. I think we could gain 75 percent efficiency if we had known a little more of what we are doing, of what you should know or do know about the crops. The grasses that are not giving the yield for pastures are probably just the grasses that we want for roadsides. We have got to get some to grow on the packed shoulder that will keep out the weeds.

Now, Mr. Brant of North Carolina may add some of the things that I haven't thought of. I am just trying some of these things out. I was very much interested to find that we have put some lands in orchard grass and in bluegrass, and we couldn't find the bluegrass for the orchard grass. We had too much orchard grass, but that was done several years ago and we are trying to correct that. Naturally, you should all be interested in highways of the country and you can give us leads on how we can work this out in the different states so

the highways departments can approach these problems in a way that will make $1 go where $2 or $3 has been going.

F. H. Brant: I think Mr. Neale has stated our problem. I'd like to emphasize that our road shoulder problem is critical. We need to get something on the shoulder that you need not maintain at too great expense. The traffic conditions and punishment we are bound to give to that shoulder. We have to do our experimenting on a trial and error method and using much larger areas for plots than a section of one green. That is, we will have to take one entire cut on the highway and do one thing with it, or at best--modify that one particular cut slope into more than two areas. There are several things that we have noticed in this State in regard to the use of grasses and legumes for shoulder stabilization on the highway. None of the work we have done could be classified as strictly research, we use the trial and error method. One of the things we have noticed is the failure of lawn and pasture grasses and legumes on steeper slopes. We get a successful seeding, the best we know how, and get a nice green cover. The second year, it is not quite as good, the third year it is not quite as good as the second, and after that, about all we have is some kind of native grass. It seems to me that there is no possibility for the use of these finer lawn and pasture grasses. We need to get down to scientific research and find out what we can do to hold them there. The second thing we have is the value of temporary cover crops, grains and Sudan grass for immediate seeding on new construction regardless of the time of year; whether it is July or August, or the middle of the winter. I feel we have had considerable success along that line. There again we are badly in need of a little more opportunity to observe small experimental plots under strict planning and strict control. And the third thing that we have found over a period of years, and particularly this year, is the great value of mulch. I personally am sold on the mulch, whether you use it in decks with seeding or just mulch alone.

Another thing we have been trying to check on this past year is the method of fertilizing. Not so much on different types of fertilizers as the times of year in which they are put on, and I have come to the conclusion that small amounts frequently give us much better results under roadside conditions than putting on a large quantity or ordinary quantity of fertilizer at the time seeding is done.

There is another question that is bothering me a great deal. I express my opinion to others in more emphatic language than I do here in regard to the use of Kudzu on roadsides. I still have an open mind on it, but at the present time, I can't see it. It does not give to my mind the complete cover, and the rapid enough cover, that we need along the roadside where we must also consider appearance. I say that I have an open mind on it; perhaps it is not

exactly open, but anyhow, I am willing to listen to argument the other way. Those are some of the points which we have been checking on in North Carolina during the last year in particular, and also during the last three or four or five years in general.

Chairman: There is an interesting thing about the farming which Mr. Neale and Mr. Brant face. Compare their problem with any farm—take a twenty or thirty-acre farm field and you have a reasonably uniform type of soil from one end to another; but when they come to plant twenty or thirty acres, they spread out for several miles. In the strip Mr. Neale referred to sheep fescue that he planted several years ago, the sheep fescue held up just beautifully even though the area was planted with the same mixture, in the other area sheep fescue disappeared entirely. The use of lespedeza comes up at certain times. It stands up beautifully and then in the winter goes down, and the ground is real soft along the shoulders. In this section, of course, we have an enormous amount of low areas, a great assortment of conditions where no type of work which would probably profit more from research work in grass and legumes than that particular field because they have so many different conditions in such a short territory.

Question: Some of the ground covers are too expensive. Others are not approved. A lady located on one of our highways came out and asked, "What are you all planting?" "I don't know—some seed they sent us from Richmond—so much rye grass, so much clover, and so much Bermuda". She replied: "That is all right as long as you are not planting wire grass". We call it Bermuda on the roads. We have to experiment a good deal with some of the various ground problems to get a uniform sod. It cost a little more than eight thousand dollars a mile for top soil on one project. That is going into big figures, but if we can get a uniform grass or uniform sod, we don't mind the amount. We don't mind getting into the lower ground covers when we are going through a residential area. We naturally want to get the sod comparable to the lawns on the side, so that presents another problem. Every mile of the road that we travel along has a completely different problem.

Tabor: I might answer for the soil conservation specialists who are gone regarding the use of Kudzu on roadsides. I happened to see some tests at the Appalachian Forest Experiment Station about two weeks ago. There the method used was to take a section of the roadcut and plant it to a single species. They have, I believe, some fifteen or twenty different species planted in this way, and they are able to use rather small plots. As I recall, their plots are not more than 50 feet in length. They too are having trouble with Kudzu because it is a little too vigorous for them, and they were complaining particularly about the Kudzu filling up the ditch. In a case like that, the engineer and whoever is handling the agronomic work or the road cover work, must get together and each give and take a little. If you are going to use Kudzu to cover up the road embankments, it seems to me that you will need a

little bigger ditch and probably you will need a torch to burn that Kudzu once or twice. You can use Kudzu very successfully on the shoulder and still keep your road ditch open. Now, there are places I know where Kudzu ought not be used. There are quite a lot of places where it seems Kudzu is the most promising thing we can get. I would like to bring out that probably some of this covering of road shoulders would call for a slightly different design in road building than we are using at the present time.

Chairman: Are there any comments?

Brant: I agree with getting this change in ditch design. They are building roads now right straight through instead of around hills, even in the lower Piedmont area and that matter of the Kudzu in the ditches and on the shoulders is one thing that I didn't bring out. It is one of my principal objections to it. In addition, it is going up into the woodland and up into the trees. In explanation of my attitude, I would like to say that on several projects we are working on this year, we are putting Kudzu along with some other plants on similar grades or slopes, and similar types of soil.

Speaker: In highway work, as you know, the grass planting is put in after work is done. And these people who have the responsibility of grassing it are not the people who design the roads. They fully appreciate what they would like to have, and what they ought to have, but their job is to do with what they have. The narrow right-of-way, of course, is not the ideal thing. But you have to get along with what you have to make the most of it. It is usually hard to get the engineers and other people who have no agricultural training whatsoever to appreciate the need for that compromise. Grass comes out on the short end of that compromise every time.

5. Airports, playing fields, etc. - How to measure wearing qualities and persistence of the various plants

Chairman: Any other road questions? If not, we go to a rather closely related one and a new one. In this country we use concrete runways on airports, but grass is having a very important place in this program of airport development. I understand Mr. Stephens had some experience with airports. I'll call on him to tell about his experience with airports.

J. L. Stephens: I have not had very much experience with the airport. I saw about six or eight this same summer and they are divided into about three classes, those that are on a low moisture soil and are extremely dry. In the clay type air field they are doing a lot of grading. The ground is rather low and apt to be leveled to the extent of ten feet in some cases. That means they move all the top soil and either fill in the low places or gulleys. It seems almost

necessary to levelthese fields, but they must apply a good grade of top soil over this area in order to get any satisfactory grass. One of the biggest problems that they have is to bring in the top soil quite a distance because the field in Albany had a top soil that was very low in organic matter, and was a loose sand.

Chairman: I think the one item of six inches of top soil is a problem. I think you will realize that from the figures I just obtained from one district visited this last week. They have 7,000 acres of grass to plant. Now figure out that six inches of top soil over 7,000 acres of ground, and figure out a $1 or $1.50 a yard for top soil. Get the conception of the cost of this grass, and the need for information that will cut that cost, if it is at all possible. Now we do have one of our grass men, a man who has not only the experience with the grasses, but who is a flyer. We want to get him to give us some idea of what they are driving at in cover on these air fields. Bengtson is the man to keep the ship right side up.

Discussion Led by John Bengtson

The fields with most of the problems, perhaps, are the ones that the Army or Civil Aeronautics have been developing for pilot training. One of the worst things they have to contend with is dust when they land their planes on turf. Dust wrecks the motor and you have motor failure which means the lives of quite a few men. The Army spends upwards of $10,000 for training the Army pilot. Well, that gives some idea of the magnitude of the problem. The factor of dust is important and the only way they have of cutting down on that is the growing of grass for cover over these fields. One of the common causes of accidents in landing of ships is when you run them off the runways and spill over. It is true that this type of accident doesn't always kill the pilot. Damage to the plane does cut down on the defense program involved. This can be avoided with a large area of suitable turf. Propellers develop a speed of wind and they will blow sand from underneath plants. You will actually see places where grasses are standing and the sand has been blown right clear from them. I wouldn't know what the solution is, and I think no one does know the real solution of covering to get the absolute maximum density of turf in there to stop it. There are, no doubt, any number of cases where they have planted grasses on the poorest type of soil, and yet they have made no attempt to fertilize it.

Chairman: In one case down in Florida last week, during dry weather, they had a column of dust three hundred feet in the air. No planes could land on the field at all. How on earth are they going to get grass over that in a hurry? I think it is going to take all the scientific information we have in all the grass fields. They don't want these heavy high-growing grasses. I saw cases this fall where good stands of Bermuda grass had been choked out by allowing tall grasses and weeds to come high and crowd the grass out.

## Attendance at Grassland Conference

Raleigh, N. C. - July 21-23, 1941

| Name | Institution | Address |
|---|---|---|
| O. S. Aamodt | Bureau of Plant Industry | Washington, D.C. |
| T. F. Akers | U. S. D. A. | West Point, Miss. |
| H. R. Albrecht | Ala. Agr. Exp. Sta. | Auburn, Ala. |
| E. D. Alexander | Ga. Extension Service | Athens, Georgia |
| L. D. Baver | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| J. W. Bengtson | U.S. Golf Assoc. (Green Sec.) | Washington, D. C. |
| H. W. Bennett | Miss. Agr. Exp. Sta. | State College, Miss. |
| L. S. Bennett | N.C. Crop Imp. Assoc. | Raleigh, N. C. |
| H. H. Biswell | U. S. Forest Service | Asheville, N. C. |
| L. V. Blake | U. S. D. A. | Wenona, N. C. |
| R. E. Blaser | Fla. Agr. Exp. Sta. | Gainesville, Fla. |
| A. E. Brandt | S.C.S. - Research | Washington, D. C. |
| F. H. Brant | State Highway Commission | Raleigh, N. C. |
| W. H. Brittingham | Texas Agr. Exp. Sta. | College Station, Tex. |
| E. Marion Brown | University of Missouri | Columbia, Missouri |
| Glenn W. Burton | Ga. Agr. Exp. Sta. | Tifton, Georgia |
| Frank S. Chance | University of Tennessee | Greeneville, Tenn. |
| W. H. Chapman | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| J. G. Collison | | Greensboro, N.C. |
| T. L. Copley | S.C.S. | Raleigh, N. C. |
| R. W. Collins | Forest Service | Wenona, N. C. |
| Joseph F. Cox | AAA - Extension | Washington, D. C. |
| S. L. Daughtridge | S.C.S. | Raleigh, N. C. |
| N. R. Ellis | U.S.D.A. - Animal Nutrition | Beltsville, Md. |
| E. W. Faires | Coastal Plain Sta. | Willard, N. C. |
| L. A. Forrest | S.C.S. | Raleigh, N. C. |
| J. E. Foster | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| E. O. Fippin | T. V. A. | Knoxville, Tenn. |
| E. B. Garrett | S. C. S. | Raleigh, N. C. |
| P. J. Gibson | N.C. Agr. Exp. Sta. | Asheville, N. C. |
| John P. Gray | La. Agr. Exp. Sta. | Baton Rouge, La. |
| C. D. Grinnells | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| A. L. Grizzard | Va. Agr. Exp. Sta. | Blacksburg, Va. |
| J. O. Halverson | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| E. M. Hansen | Solvay Process Co. | Raleigh, N. C. |
| Clarence Hanson | University of Missouri | Columbia, Mo. |
| M. A. Hein | Bureau of Plant Industry | Washington, D. C. |
| B. H. Hendrickson | Piedmont Exp. Sta. | Athens, Georgia |
| Paul R. Henson | U. S. D. A. | Beltsville, Md. |
| P. G. Hogg | Miss. Agr. Exp. Sta. | State College, Miss. |
| Earl Hostetler | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| M. M. Hoover | S. C. S. | Washington, D. C. |
| Howard L. Hyland | U. S. D. A. | Washington, D. C. |
| Edwin James | University of Georgia | Athens, Georgia |

| Name | Institution | Address |
|---|---|---|
| J. S. Joffe | N.J. Agr. Exp. Sta. | New Brunswick, N.J. |
| Mrs. Estha Joffe | N.J. Agr. Exp. Sta. | New Brunswick, N.J. |
| G. H. Jones | University of California | Davis, California |
| Lloyd Jones | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| C. M. Kincaid | Va. Agr. Exp. Sta. | Blacksburg, Va. |
| J. P. LaMaster | Clemson College | Clemson, S. C. |
| F. J. LeClair | S. C. S. | Chapel Hill, N.C. |
| C. L. Lefebvre | Bureau of Plant Industry | Washington, D. C. |
| S. G. Lehman | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| R. W. Lipscomb | Clemson College | Clemson, S. C. |
| R. L. Lovvorn | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| R. H. Lush | National Fertilizer Assoc. | Washington, D. C. |
| Roland McKee | Bureau of Plant Industry | Washington, D. C. |
| F. J. D. Mackay | T. W. Wood & Sons | Richmond, Va. |
| A. C. Mathews | S. C. S. | Chapel Hill, N. C. |
| H. L. Meacham | Barrett Co. | Raleigh, N. C. |
| G. K. Middleton | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| F. M. Milam | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| W. M. Myers | Regional Pasture Research Lab. | State College, Pa. |
| H. J. Neale | Va. Dept. of Highways | Richmond, Va. |
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| W. O. Ree | S. C. S. | Spartanburg, S.C. |
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| J. A. Rigney | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
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| H. F. Robinson | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| E. F. Schultz, Jr. | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| D. M. Seath | La. Agr. Exp. Sta. | Baton Rouge, La. |
| O. E. Sell | Ga. Agr. Exp. Sta. | Experiment, Ga. |
| Weldon O. Shepherd | Ga. Agr. Exp. Sta. | Tifton, Georgia |
| Ben W. Smith | N.C. Agr. Exp. Sta. | Raleigh, N. C. |
| J. T. Spencer | Ky. Agr. Exp. Sta. | Lexington, Ky. |
| J. L. Stephens | Ga. Agr. Exp. Sta. | Tifton, Georgia |
| J. W. Stevenson | Ga. Agr. Exp. Sta. | Tifton, Georgia |
| R. E. Stitt | U. S. D. A. | Statesville, N.C. |
| Paul Tabor | S. C. S. | Spartanburg, S.C. |
| J. H. Torrie | University of Wisconsin | Madison, Wisconsin |
| E. W. Turner | Va. Dept. of Highways | Richmond, Va. |
| J. L. Vandiver | Tenn. Tobacco Sta. | Greeneville, Tenn. |
| J. B. Washko | University of Tennessee | Knoxville, Tenn. |
| J. L. Weimer | U. S. D. A. | Experiment, Georgia |
| Herbert L. Wilkins | Agr. Research Center | Beltsville, Md. |
| C. J. Willard | Ohio Agr. Exp. Sta. | Columbus, Ohio |
| H. P. Wood | Farm Security Adm. | Raleigh, N. C. |
| W. W. Woodhouse, Jr. | N.C. Agr. Exp. Sta. | Raleigh, N.C. |
| T. E. Woodward | U.S.D.A. -B.D.I. | Beltsville, Md. |

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